POWER

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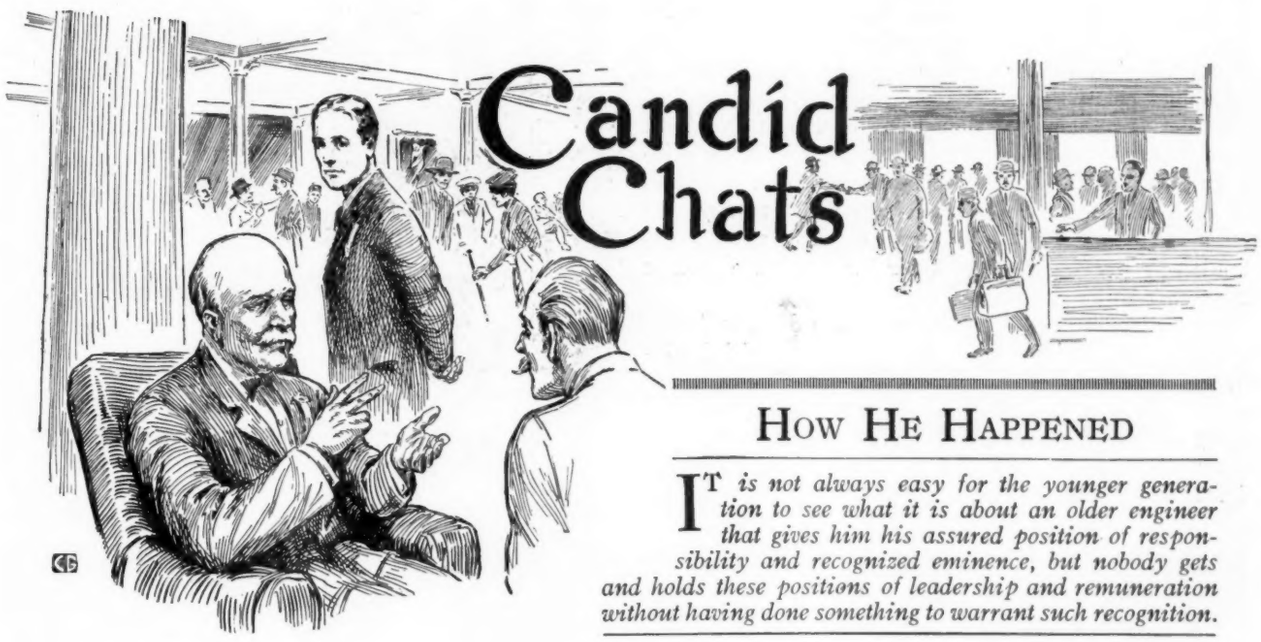


Candid Chats

How He Happened

IT is not always easy for the younger generation to see what it is about an older engineer that gives him his assured position of responsibility and recognized eminence, but nobody gets and holds these positions of leadership and remuneration without having done something to warrant such recognition.

ONE of these veteran engineers was present at a recent convention. We knew him when he was winning his spurs. He had already made a hit by saving money in the power plant of a large textile mill, and was asked to undertake to do it for another with the distinct understanding that there was no money available for improvements. The cost of operating the steam plant for the six months preceding his taking charge of it was upwards of $36,000, as given in the first column of the accompanying table, and they made 812,363 pounds of cotton cloth, besides running four woolen mills and furnishing steam for the dyehouse. Based upon the cotton cloth alone, this would give a cost of power plant operation per pound of cloth of 4.47 cents. For the first six months of his management the cost for the same items fell to $25,544, as shown by the second column, and this notwithstanding an increase of over fifty per cent. in the amount of cloth produced. This brought the operating cost of the power down to 2.06 cents per pound of cloth produced. There was a rise the next year to 2.21 cents, which was still, however, less than half of the cost per pound before he took hold, and on the third six months of his stay he reduced it to 1.69 cents.

If the operating cost of the power plant had been the same per pound during the first half of 1884 as it was before he came it would have cost nearly $37,000 more than it did cost to run the plant. Of course, the greater production made for a lower cost per pound, but he actually ran the plant with the expenditure of about $14,000 less money and made 1.63 times as much cloth with it.

For this achievement he received the first year the munificent salary of $2000; but he made good. Other and larger plants offered larger opportunities and he went to them, and did what was expected of him. That is why he is a leading engineer now. There are plenty of plants today where savings of this sort can be made.

There are plenty of men who could make such savings if they were given a free hand.

More confidence in the engineer on the part of the employer and more confidence in himself on the part of the engineer are what is needed to bring the man and the opportunity together.

Items	6 mo. ending Dec. 31, 1882	6 mo. ending June 30, 1883	6 mo. ending Dec. 31, 1883	6 mo. ending June 30, 1884
Grate coal	$27,969.15	$11,301.40	$859.10	
Pea coal		8,662.50	10,107.00	$14,791.50
Culm			10,316.00	2,208.00
Wood	1,340.00	136.00	84.00	76.00
Oil and grease	418.15	269.25	414.50	274.00
Pay roll	6,600.00	5,175.47	5,705.94	5,015.96
Total	$36,327.30	$25,544.62	$27,486.54	$22,365.46
Cloth woven, lb.	812,363	1,235,784	1,241,763	1,325,712
C. per lb.	4.47	2.06	2.21	1.69

Draft and Stoker Control at Waterside

By Charles H. Bromley

SYNOPSIS—Describes the means for controlling the draft under the fire and the stoker speed at the Waterside Stations of the New York Edison Co. Also illustrates the stoker-control system in the 201st St. Station of the United Electric Light & Power Co., New York City.

In Waterside Station No. 2, the 650-horsepower water-tube boilers are arranged back to back in two rows, six boilers to a row, the main flue being between the rows. Underfeed stokers are used and the draft is furnished by engine-driven blowers pumping air into a main duct below the boiler-room floor. At each end of this duct is a blower designed for 60,000 cu.ft. of air per min. against a head of 2 in., the blowers being originally used for the hand-fired furnaces before the stokers were installed. These blowers or fans are now run faster to increase both the pressure and capacity demanded by the draft required for the underfeed stokers and higher boiler capacity.

For controlling the air pressure in the duct, and consequently the draft under the fires, a multiple-diaphragm regulating valve governs the speed of each fan engine. Before investigating the details of the diaphragm valve, it is best to understand the air connections between the fan engines and the ducts. The diagram, Fig. 1, shows that at the middle of the main air duct

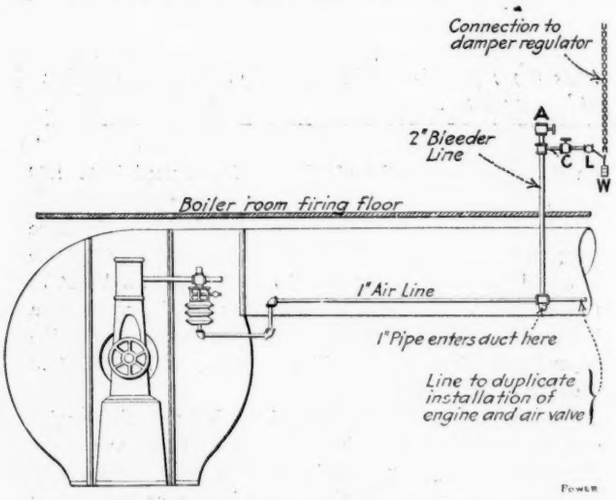


Fig. 1. Connections to Diaphragm for Regulating Pressure in Air Duct for Underfeed Stokers

a 1-in. pipe enters. To this short 1-in. piece, a 2-in. cross tee is connected and from one side and bottom of the latter, 1-in. pipe connects to the bottom of each diaphragm. The top of the cross tee contains a length of 2-in. pipe going directly through the floor to an alley between Nos. 3 and 4 boilers, the end of the pipe having a 2-in. valve opening to the atmosphere. This 2-in. pipe rises about four feet above the floor, so that the valve is most conveniently reached.

The diaphragm regulator is simply a balanced valve actuated by the diaphragms, which in turn are moved by the air pressure from the duct. As the pressure on the diaphragm is very little compared to that necessary to move the valves controlling each of the engines, there must be considerable diaphragm area, especially if the valve is to be sensitive. Therefore, six diaphragms, having a total area of 70 sq.in., are used. A lever and ball

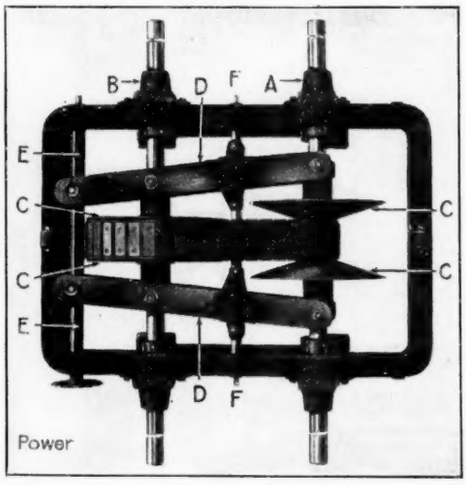


Fig. 2. Transmission Device for Driving Stoker Line Shaft at Variable Speed

for adjusting the valve for minimum pressure are provided.

As the valve is actuated by the pressure in the air duct, it is evident that various pressures within the capacity of the fan may be carried in the duct by simply allowing a greater or lesser amount of air to escape through the globe valve *A*. The draft over the fires in any unit of six boilers is regulated by using the large baffle of the cinder arrester, the baffle extending the entire length of the flue. This baffle is moved by hand and performs the same function in this respect that individual back or uptake dampers or main dampers do. The CO_2 is higher ordinarily when the draft over the fire is maintained at about 0.05 in. of water, indicated by a U-tube on the control board, Fig. 3.

For automatically regulating the air-duct pressure between two given points, the latter being adjustable, an auxiliary bleeder valve *C* may be used, although this is not the case at Waterside. Besides the auxiliary valve *C*, a lever cock operated by a damper regulator is provided; the cock discharges to the atmosphere.

Suppose it were desired to carry ½-in. pressure in the air duct or under the fire, but to vary the pressure between one-half and three-quarter inches. The valve *A* would be opened to give the ½ in., and the auxiliary bleeder *C* would be opened to give the extra ¼ in. The exit for the air from the auxiliary bleeder is controlled by the movement of the lever cock which is actuated by the damper regulator.

Stoker Control

This method of air control is all the more useful because of the ease with which the stoker speed may be

regulated, for both controls are separate and independent. Each unit of six stokers is engine-driven through a variable-speed transmission between the engine shaft and the stoker line shaft, the latter, of course, being driven directly by the variable-speed transmission, shown in Fig. 2. The transmission consists of spline-mounted cone-shaped disks *C* acting as pulleys over which a V-belt runs. Each half of each pulley may be separated from its partner half by the movement of the levers *D* which are pivoted, the levers being operated by a screw *E*, with right- and left-hand threads, so that as the halves of one pulley move inward or toward each other, the halves of the other move away from each other in the same ratio. As seen, this amounts to varying the size of the pulleys, but it insures uniform belt tension for all speeds. To adjust the tension of the belt when this becomes necessary, take-up screws *F* are provided to allow the levers to move inward, thus adjusting the pulleys to the length of the belt. The regulating screw *E* is operated by a chain and sprockets, one of the latter being placed within arm's length of the bleeder valve for the draft system. The driver shaft is designated *A* and the driven *B*.

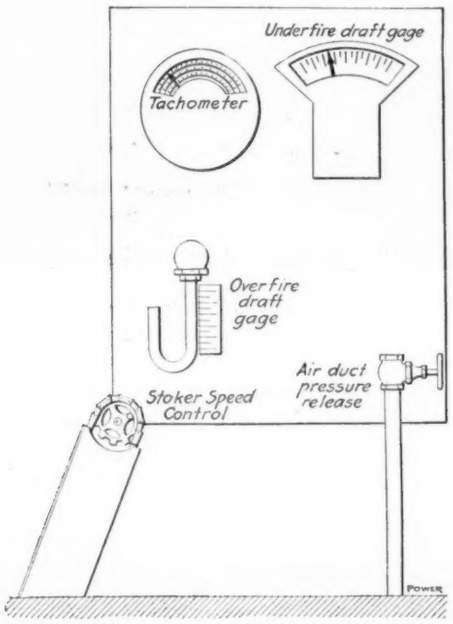


FIG. 3. DIAGRAM OF COMBUSTION CONTROL BOARD

The transmission is made in six sizes. Where about 3500 to 4000 boiler-horsepower (rated) in stokers could be driven from one line shaft, the No. 5 transmission, good for a maximum of 25 hp., would do. This size machine installed costs about $275 or $11 per horsepower. The costs will, of course, increase slightly for machines of smaller powers.

THE CONTROL BOARD

In an alley between boilers Nos. 3 and 4, a control board shown diagrammatically in Fig. 3 is placed. This board has an electrical tachometer with three scales, one calibrated for air pressure, one for pounds of coal per hour, and one for indicating the stoker speed, a pointer-indicating gage to show the draft under the fire and a U-tube gage to indicate the draft over the fire. As shown, the stoker-speed regulator and air-pressure bleeder valves are near the board. At one end of the firing aisle, between two units of six boilers each, are two large steam-flow meters, one for each unit of six boilers.

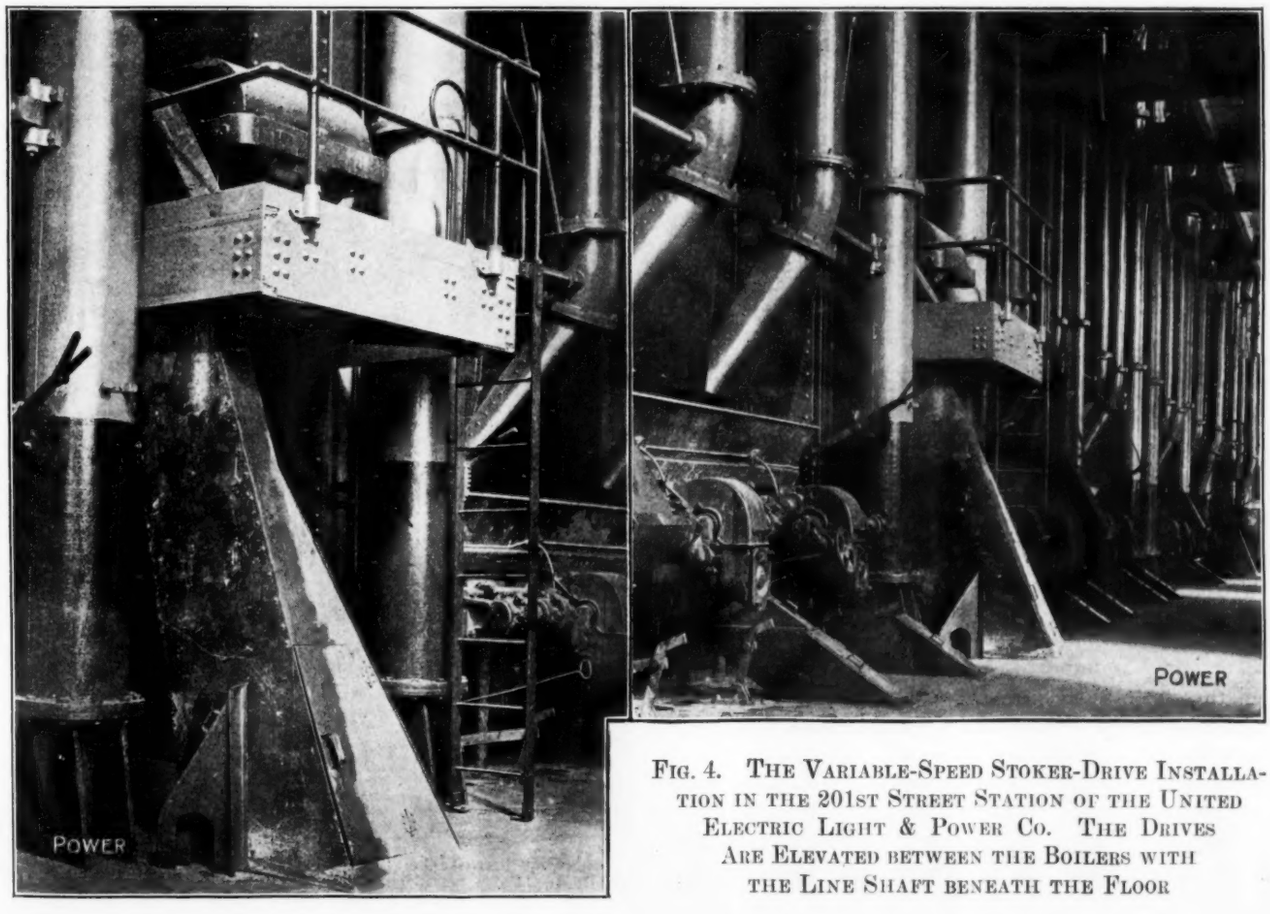


FIG. 4. THE VARIABLE-SPEED STOKER-DRIVE INSTALLATION IN THE 201ST STREET STATION OF THE UNITED ELECTRIC LIGHT & POWER CO. THE DRIVES ARE ELEVATED BETWEEN THE BOILERS WITH THE LINE SHAFT BENEATH THE FLOOR

It is seen that with these provisions the fireman knows how much the output of each unit is, how it compares with the other units on the line, and, when more or less capacity is needed, he may have it by a simple, quickly and easily made operation. Fig. 4 shows the same kind of variable-speed stoker drive for the stokers in the 201st St. Station of the United Electric Light & Power Co., New York City. As shown in both Figs. 4 and 5, the stoker line shaft is immediately below the floor while the drive is elevated between two boilers and is motor driven. The speed-regulating sprocket wheel is within convenient reach of the fireman. At Waterside the transmission device is below the boiler-room floor as shown in Fig. 6.

The variable-speed drive for the stoker is the product

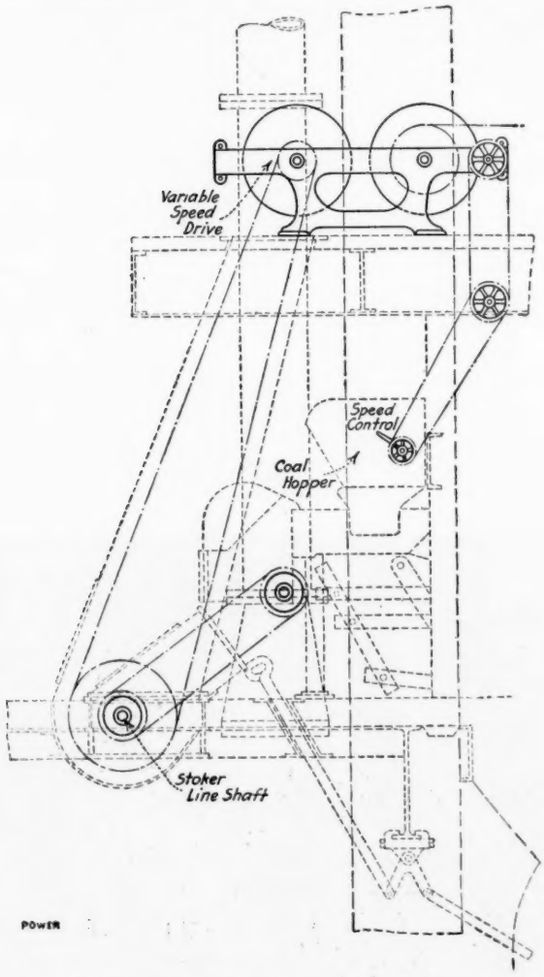


FIG. 5. DIAGRAMMATIC LAYOUT OF THE STOKER DRIVE AT 201ST ST.

of the Reeves Pulley Co., Columbus, Ind.; the diaphragm draft control installation was made by the Pitts & Kitts Manufacturing & Supply Co., New York City. A Precision Instrument Co.'s draft gage is used, and the stoker speed is indicated by a Hopkins electrical tachometer.

In an effort to eliminate as much as possible the human element in governing combustion, the tachometer is so adjusted that it and the underfire draft gage will read alike when combustion is best. So, as far as the fireman is concerned, all he has to do is to manipulate the stoker-speed regulator and the air-bleeder valve until they reg-

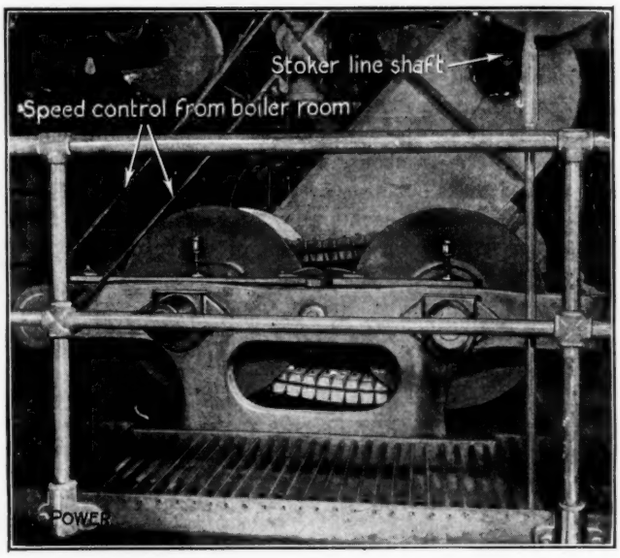


FIG. 6. THE TRANSMISSION DEVICE BELOW THE BOILER-ROOM FLOOR AT WATERSIDE

ister alike and the steam-flow meter shows the unit to be doing its share of steam making. As several varieties of coal with varying characteristics are used in the Waterside stations, it becomes necessary to adjust the tachometer for the varying coal conditions.

Fig. 7 shows the diaphragm valve.

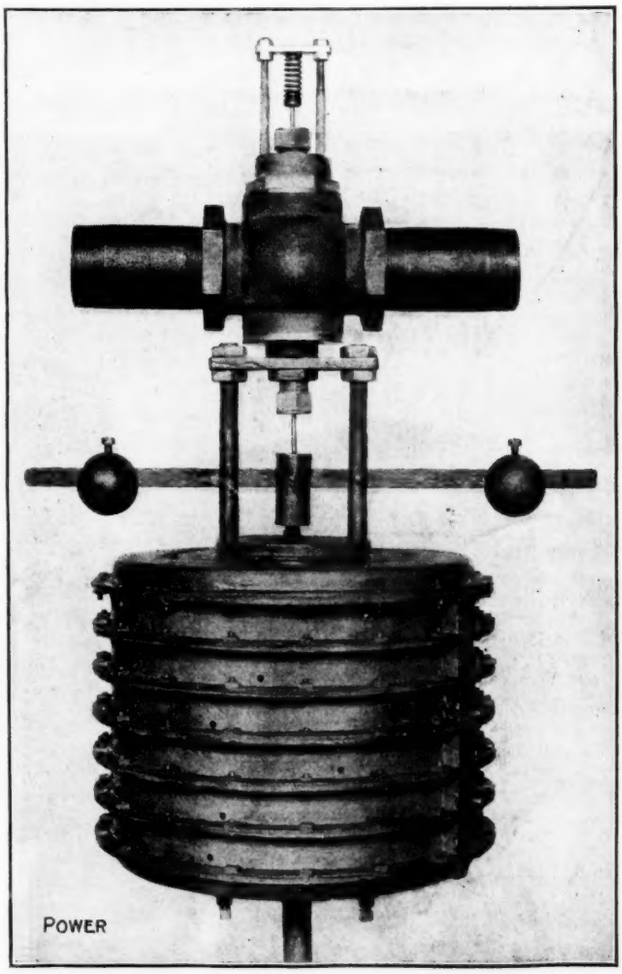


FIG. 7. THE DIAPHRAGM REGULATING VALVE

The First Stumpf Una-Flow Engine Built in America

SYNOPSIS—The first una-flow engine built in America with the coöperation and approval of Professor Stumpf uses only 12.5 lb. of steam per i.hp.-hr. condensing and 16.8 noncondensing, the minimum consumption being at one-half load in both cases. It is only 15x16 in., runs at 250 r.p.m., and is designed to carry 100 kw. at rating.

A number of engines have been built in America upon the una-flow principle, but the first to be built with the consent and approval of Professor Stumpf, under his patents and designed by the engineers of his representative, the Stumpf Una-Flow Engine Co., who know his standards and methods, is that built by the Ames Iron Works, of Oswego, N. Y., and illustrated herewith.

This engine consists of a 15x16-in. cylinder mounted upon a standard heavy-duty frame. About as many expansions are attainable with the una-flow in a single cylinder without excessive cylinder condensation as are practicable in the two cylinders of a compound, but on account of the absence of loss between cylinders, etc., the una-flow cylinder may be made about 20 per cent. smaller than the low-pressure cylinder of an equivalent compound without loss of efficiency. The full boiler pressure acts upon the large piston, necessitating attention to the large initial stress.

The engine is pleasingly simple in appearance, as will be recognized from Fig. 1; and its internal arrangement and construction are just as simple. Fig. 3 shows a longitudinal and cross-section through the cylinder. Steam enters by the poppet valve in the head, is cut off early in the stroke even at full load, and exhausts through the ports in the middle of the cylinder, when they are opened by the piston passing over them. The piston is shorter than the stroke only by the width of the exhaust port. If, for instance, the piston were $\frac{9}{10}$ as long as the stroke and the port $\frac{1}{10}$, release would take place when the stroke was $\frac{9}{10}$ completed and compression would commence when the piston had proceeded $\frac{1}{10}$ of the way on its backward stroke. If, when the piston covers the exhaust port on the backward stroke, the pressure in the cylinder is low, as when the engine is exhausting into a condenser, the compression, even with a moderate clearance, would

TESTS MADE WITH A 15x16-INCH STUMPF UNA-FLOW ENGINE

	Oct. 5, 1914 —Noncondensing—Saturated—				June 6, 1914 ——Noncondensing—Superheated——					Sept. 5, 1914 ——Condensing—Superheated——					
Test no.	I	II	III	IV	I	II	III	IV	V	I	II	III	IV	V	VI
Load	¼	½	¾	full	Friction	¼	½	¾	0.85	Friction	¼	½	¾	Full	1¼
Steam pressure, lb. per sq.in.	146	145	145	146	138	140	140	140	137	147	145	145	145	140	140
Speed, r.p.m.	257	256	255	254	262	258	255	253	252	...	...	255	...	...	...
Superheat, deg. F.	...	...	...	...	132	117	130	118	114	50	96	88	93	103	140
Vacuum, in.	...	...	...	...	...	...	...	...	...	26	26	25½	25½	25	24
Load on generator. Amperes	100	200	300	400	...	100	200	300	350	...	100	200	300	400	600
Load on generator. Volts	250	250	250	250	...	250	250	250	250	...	250	250	250	250	250
Indicated horsepower, hp.	55.5	93.4	130.8	171.7	12.9	56.3	92.5	134	152.3	11.5	53	93	131	175.5	257
Steam consumption, lb. i. hp.-hr.	21.0	20.4	20.8	21.3	18.0	17.3	16.8	17.0	17.3	15.0	13.2	12.5	12.5	12.9	15.3

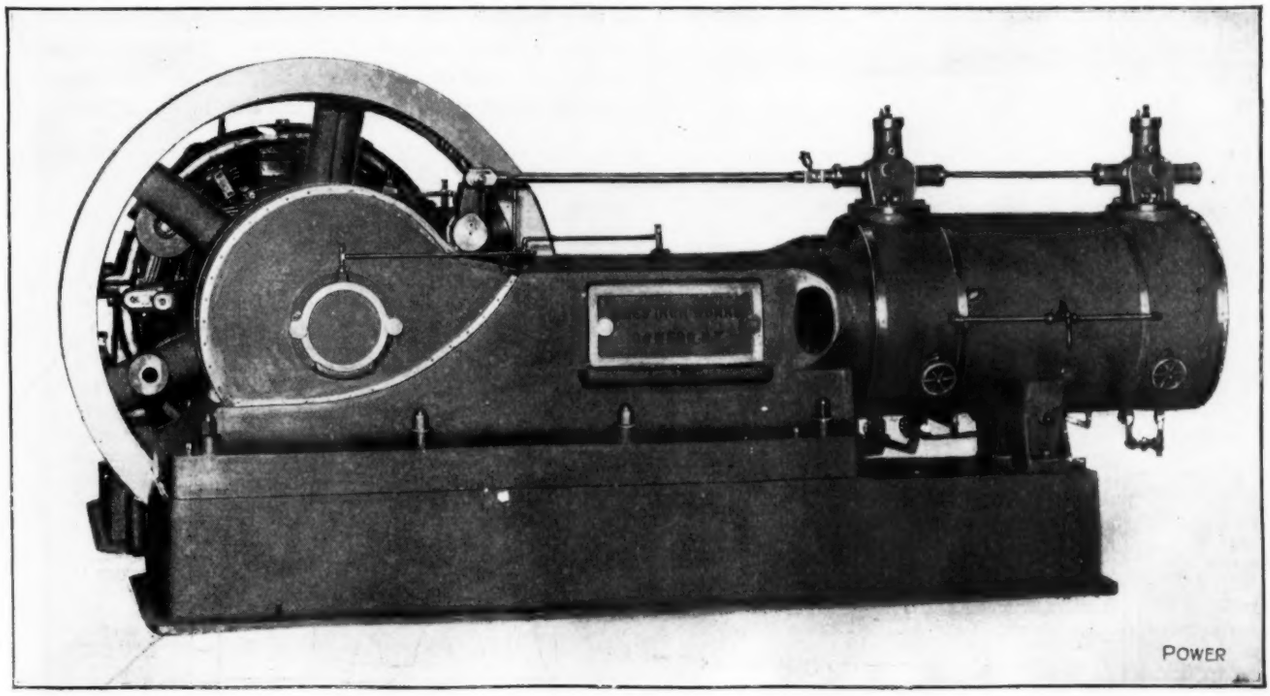


FIG. 1. THE FIRST STUMPF UNA-FLOW ENGINE BUILT IN AMERICA

not be very high. With the exhaust ceasing at $\frac{1}{10}$ of the return stroke there would be $\frac{9}{10}$ of the cylinderful of steam to be compressed into the clearance.

Suppose this to be at the pressure of 2 lb. absolute, about 26 in. of vacuum, and suppose the clearance to be 5 per cent., we have, assuming the pressure to vary inversely as the volume,

$$\frac{2 \times 0.95}{0.05} = 38 \; lb.$$

showing that even with this early closure the compression would run up to only a moderate amount. If, however, the pressure at the instant that compression commenced were that of the atmosphere, say 15 lb. absolute, there would be with the same clearance

$$\frac{15 \times 0.95}{0.05} = 285 \; lb.$$

On account of the absence of the usual exhaust port it is possible to keep the clearance very low, it being only 3.1 per cent. in this engine even with its short stroke. For a noncondensing engine it is necessary, however, to have a greater clearance volume when the closure of the exhaust is thus early in the stroke. Professor Stumpf argues that the harmful effect of clearance, due to its volume, is slight compared with that due to its surface, and

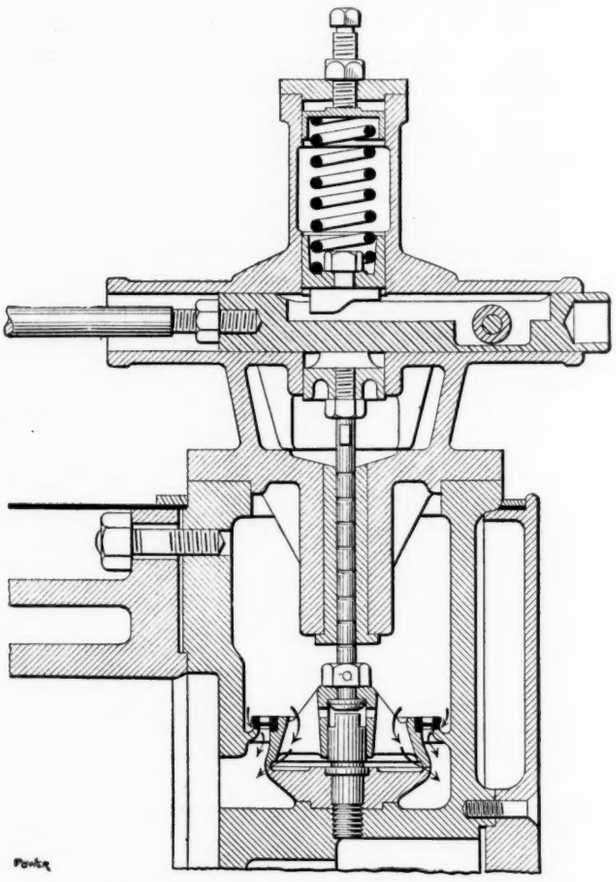


FIG. 2. ADMISSION VALVE AND GEAR

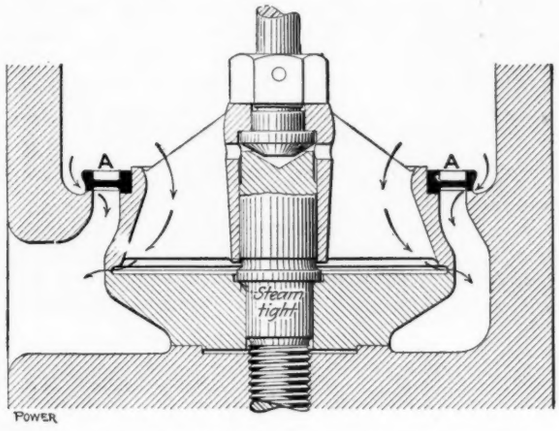


FIG. 4. DOUBLE-BEAT POPPET ADMISSION VALVE

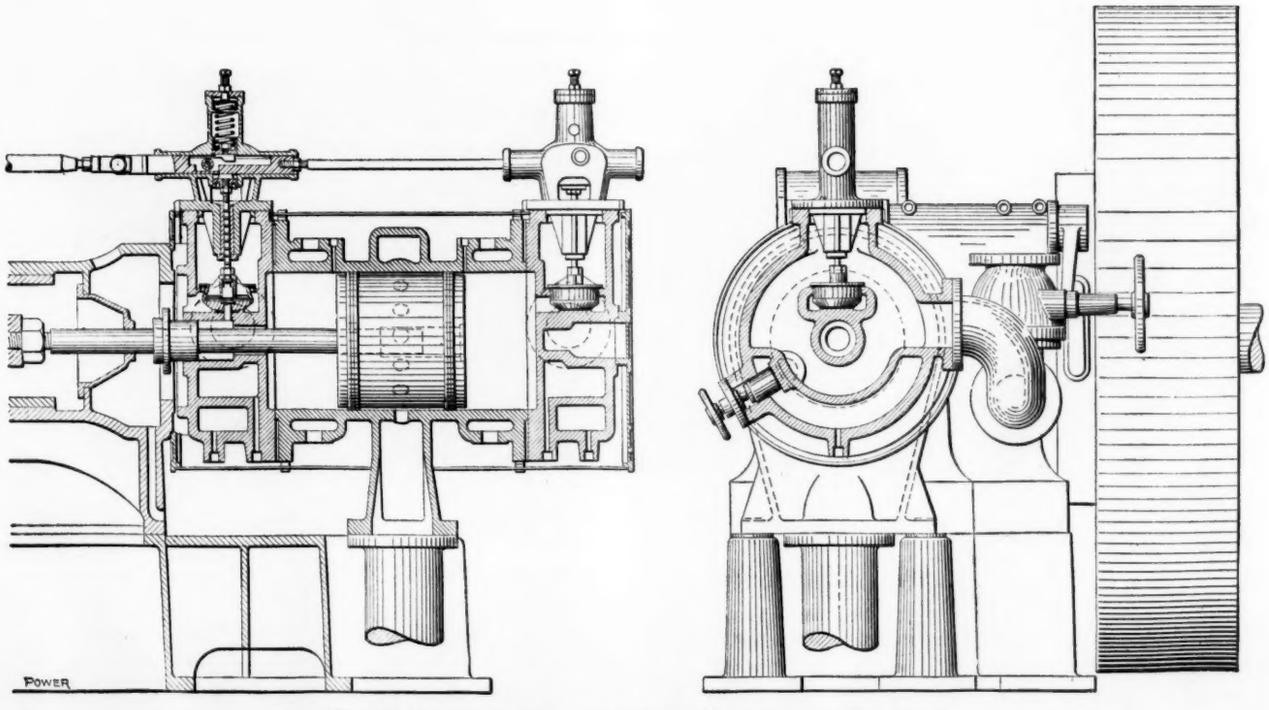


FIG. 3. LONGITUDINAL AND CROSS-SECTION OF CYLINDER

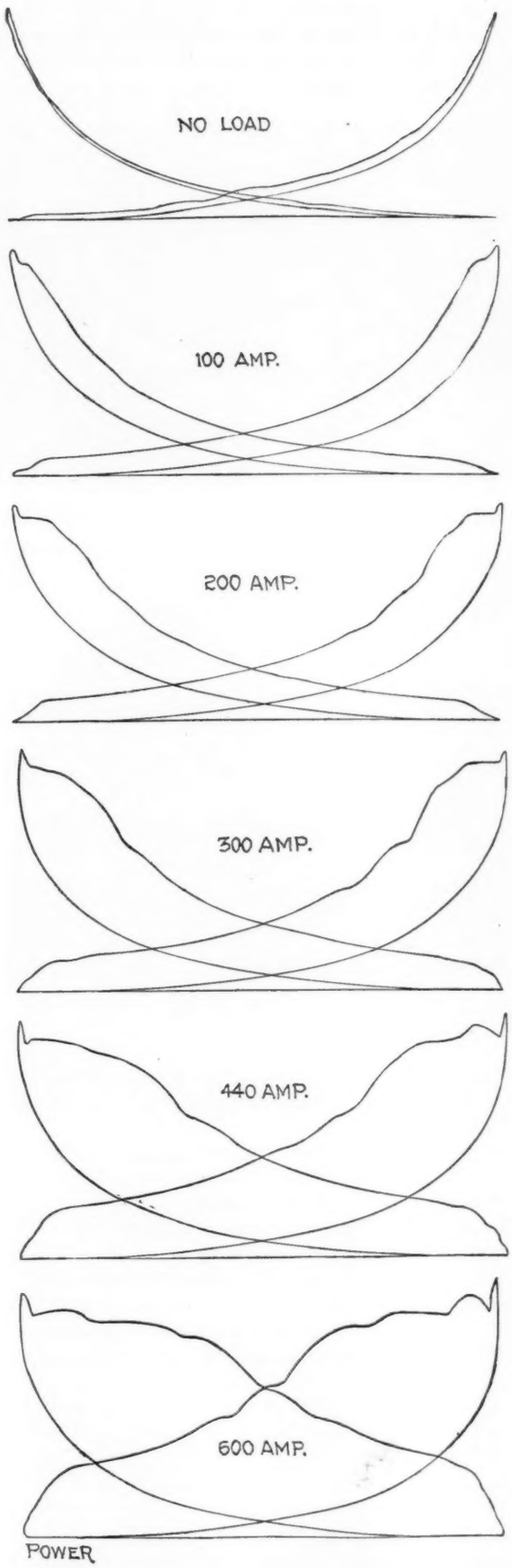


FIG. 5. DIAGRAMS FROM NO LOAD TO 50 PER CENT. OVERLOAD

the engine designed to run noncondensing only has a piston, the head of which is turned out concave. This gives the required increase of clearance volume with the least possible amount of bounding surface. With an engine designed to run condensing a minimum amount of clearance is used, the piston being built in the usual way. In order to meet emergency conditions, as when the condenser drops its vacuum and the engine must run temporarily noncondensing, a clearance pocket is provided in the head, as shown in the cross-section in Fig. 3, the connection of which with the cylinder is controlled by the valve shown. When, for any reason, the engine has to run noncondensing, this valve is opened, connecting the pocket with the working cylinder and the clearance is increased and the compression kept down, although with a slight impairment of the efficiency on account of the addition to the containing surface. If desired the valve controlling the connection between this pocket and the cylinder may be made to open automatically, precluding the generation of excessive pressure by an accidental loss of vacuum.

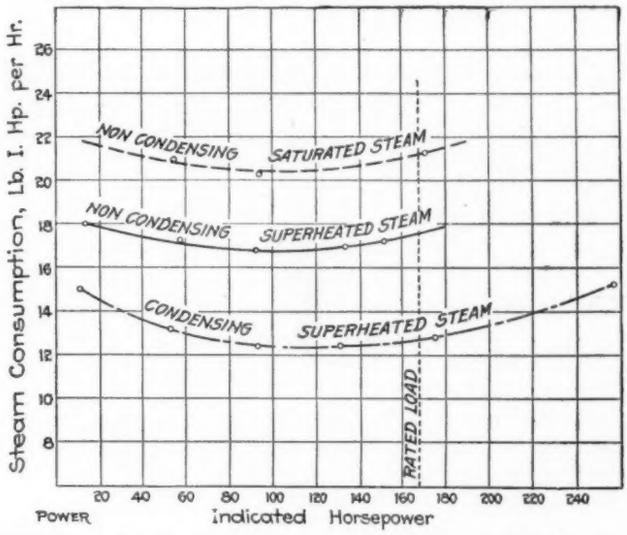


FIG. 6. SHOWING THE FLATNESS OF THE LOAD CURVE

The passages surrounding the cylinder between the exhaust belt and the cylinder heads are steam jackets, the motive of the engine being to preserve a hot end or zone for the entering steam; and as the exhaust does not come back through this zone it carries off no heat from it, which explains the economical results obtained by the unidirectional method of flow.

In order to adapt the engine to the use of high degrees of superheat, poppet valves are used, and one of the remarkable things about the running of the engine is the noiselessness and ease with which these valves are handled at 250 and more revolutions per minute. The operating rod extends across both valves as shown in Figs. 1 and 3 and receives its motion through a rocker arm from the governor eccentric. Where it passes through the valve bonnet, Fig. 2, its section is circular, with a recess in which is carried a roller. This roller, by contact with a suitably designed cam surface, lifts the valve quickly from its seat, and in closing permits it to approach the seat rapidly, but to be brought into actual contact at a diminishing rate which makes no perceptible impact. The cam is kept in contact with the lever, and the balanced valve upon its seat, by the spring shown at the top. The piston immediately below the roller-car-

rying section is merely a guide. The valve stem depends upon its length, good fit and water grooves for steam tightness, a method long ago used successfully by Professor John Sweet.

The well known difficulty of keeping a double-seated valve tight on both seats at the same time is met by making the upper lip of the valve sufficiently flexible to be pressed onto its seat by the steam pressure. Fig. 4 shows the valve on a larger scale. The cross-hatched portion is of cast metal. The upper lip, shown in solid black, is made by shrinking on a steel ring and then turning it to the section shown, the thin center deflecting enough under pressure to allow the outer ring to seat tightly.

The table on page 701 shows some results obtained with this engine upon the testing floor of the builder's shops at Oswego, N. Y., where they are exceptionally well equipped for such determinations. In Fig. 5 are shown a series of diagrams from friction to 50 per cent. overload. Steam consumptions of 12.5 and 17 lb. condensing and noncondensing are remarkable for an engine doing less than 100 hp. and the flatness of the curve of steam consumption plotted against load (Fig. 6) will give the engine a great advantage when used for light or fluctuating loads. These results were corroborated by the editor of POWER, who, on Oct. 16, made a test of the engine, assisted by Professors Herman Diederichs and W. M. Sawdon of Sibley College, and W. Trinks of the Carnegie Institute of Technology.

With an average load of 100.8 kw. the engine developed 168.46 i.hp., giving an overall efficiency of engine and generator of 80.2 per cent. With steam of 148 lb. gage, 125 deg. superheat and exhausting at atmospheric pressure the steam rate was 17.57 lb., the heat rate 19,022 B.t.u. per i.hp.-hr. and the efficiency referred to the Rankine cycle 75.8 per cent. Every precaution was taken to obtain correct results. The weighing apparatus, thermometer, gage and indicator were calibrated, the mean effective pressure corrected for a slight inaccuracy of the indicator spring, and there is no doubt that the engine will carry the load under which it was tested with the steam consumption given.

Cooling Tower for Oil-Engine Jacket Water

By WILLIAM B. GARRISON

While stranded for a few hours in a small town recently, I used the time in visiting several power plants in the vicinity of the railroad station, one of which is of interest. It has a 400-hp. twin oil engine, Fig. 1, directly connected to a 300-kw., 110-volt alternating-current generator, running at 150 r.p.m. A triple-plunger cooling-water pump is belt-driven from a pulley on the end of the engine crankshaft.

On the outside of the brick engine house is a long 9000-gal. capacity iron tank, above which are four stands of cooling troughs over which the water from the discharge of the engine water jacket flows, Fig. 2. Beginning at the right, the first and third stands cool the water from the engine. The second stand is connected to the overflow of a 6-in. standpipe, 24 ft. high, into which the belt-driven pump discharges, taking water from the iron tank. The top of the standpipe is fitted with a safety valve, set at 40 lb. pressure. When the pressure exceeds this, the valve operates and the water flows to the cooling racks. As the water jacket is piped to the standpipe under a pressure of 40 lb., it insures a constant circulation of water.

The water from the engine comes to the cooling towers

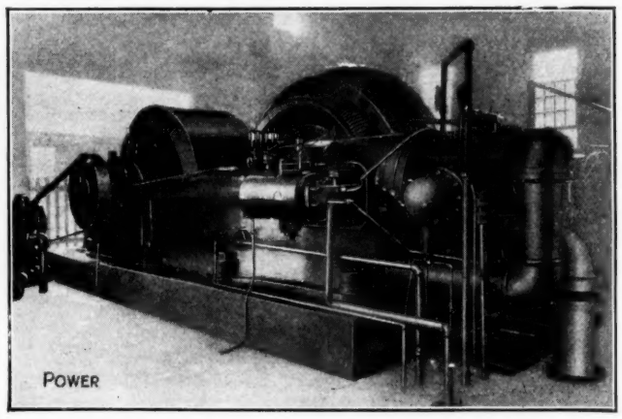


FIG. 1. TWIN OIL ENGINE OF 400 HP. CAPACITY

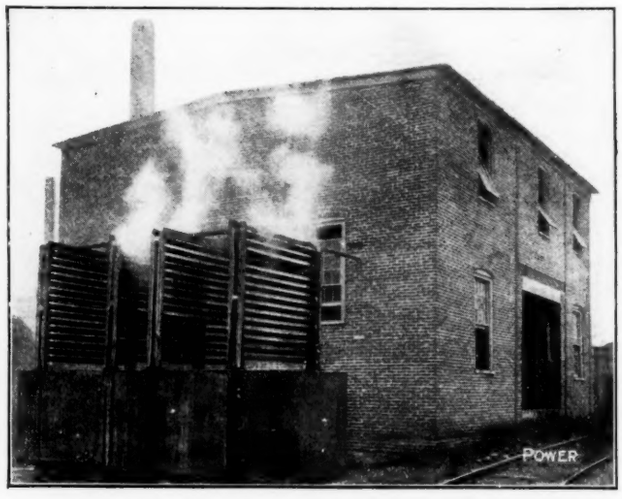


FIG. 2. COOLING WATER TOWER FOR ENGINE JACKET WATER

at from 160 to 180 deg. and is taken from the tank at 90 deg., a drop in temperature of from 70 to 90 deg., during the winter months; in summer, the drop is less.

This cooling arrangement is a good example of what can be done cheaply when cooling water is not readily available at small cost and must be had.

The fourth cooling stand is used with a small crude-oil engine in the factory, but any one of the four can be used with either engine by controlling valves in the discharge pipe above them.

The exhaust gases from the engine go to a stack shown at the rear of the engine house, and are discharged vertically.

Profitable Municipal Plant at Lodi, Calif.—The city clerk's annual report shows that Lodi has cleared $17,183.22 on its municipal light and water system during the past year. The city owns property valued at $178,354, which includes the electric light and water plants and services. During the year the city received from the sale of water and lights, $47,174.93. It costs $37,916.93 to maintain these departments. In addition to this, improvements have been made to the plants amounting to $57,935.52, giving a real profit of $17,183.22.

Cost of Rapid Erection of Six 1000-Hp. Boilers

By Jay C. Lathrop

SYNOPSIS—The time, cost and details entering into the installation of six 1000-hp. stoker-fired water-tube boilers with superheaters.

During the past year, six 1000-hp. water-tube boilers have been installed in an addition to the Westport power station of the Consolidated Gas, Electric Light & Power Co., of Baltimore. There are eleven retort underfeed stokers under each boiler, the general arrangement being shown in Figs. 1 and 2.

These boilers are of the three-pass type, and are supported upon the structural-steel framework of the building. The front and rear headers are hung from two 15-in. 33-lb. channels framed between the main building columns by means of 3-in. round rods with ball joints. Each boiler has a heating surface of 10,470 sq.ft. and consists of 472 four-inch tubes 20 ft. long expanded into the wrought-steel headers, together with four steel drums each 35⅛ in. in diameter. Each boiler is equipped with a Foster superheater, arranged to heat 31,410 lb. of water to 487 deg. F. under a steam pressure of 200 lb. These superheaters are so designed that the drop in pressure shall not exceed ½ lb. at rated load, 2 lb. at 200 per cent of rating and 4½ lb. at 300 per cent. of rating.

The gases from each boiler are carried through a vertical uptake to a breeching varying from 5 ft. at the small end to 16 ft. at the connection to the stack, the width inside being 5 ft. The construction and method of supporting this stack on the steelwork were described in Power, Oct. 13, 1914, p. 522. Cross baffle-plates were arranged in the vertical portion of the breeching just beneath the stack, dividing the stack area into four sections. Each set of three boilers has a similar breeching arrangement of which is shown in Fig. 3.

The setting for each boiler occupies a space 22 ft. 10 in. wide by 22 ft. 10½ in. long and 22 ft. 11⅜ in. high. The entire setting is supported upon the steelwork which carries the main boiler-room floor, 20 ft. above the basement floor.

Each sidewall, weighing 204,000 lb., is carried by two Bethlehem girder beams. The rear wall, weighing 34,500 lb., and the bridgewall, weighing 50,000 lb., are similarly supported. The front is taken up by the stoker, which also rests directly on steel floor-beams.

After the steelwork supporting the bridgewall and the reciprocating grates of the stoker had been erected it was found desirable to change the design of the stoker, making necessary the removal of one of the 18-in. beams supporting the bridgewall, and lowering the two beams beneath the reciprocating grate so that this grate could be lowered and placed further back, allowing more space for the clinkers.

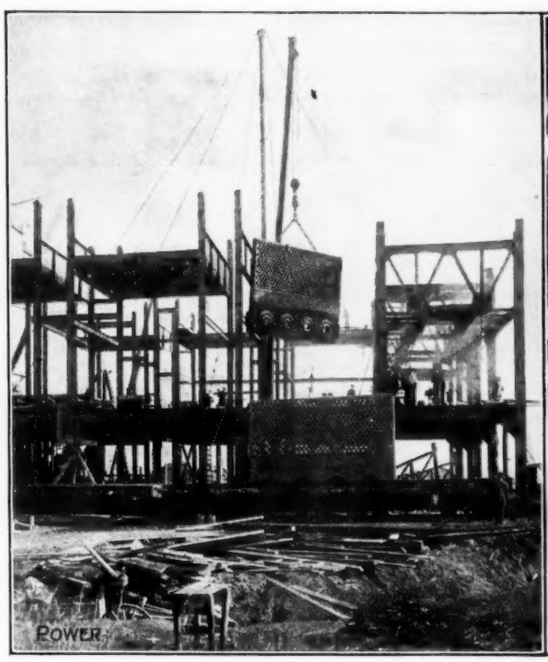


Fig. 1. Hoisting Header from Car

Fig. 2. Installing the Stokers

Stokers

The stokers are of unusual width, owing to the large capacity of the boilers, and each is made up of eleven standard retorts. The width of the stoker is 19 ft. 6 in. inside to inside of the combustion chamber, and the depth of the chamber is 8 ft. 3½ in. These stokers are provided with extension grates of the self-cleaning type which have recently been developed. This extension grate is showing up well under service, and is a desirable addition to the labor-saving machinery in a plant of this character. The forced draft for the stokers is provided

by four three-quarter-housed paddle-wheel fans directly connected to four engines which also furnish the power for driving the stokers.

Erection of Boilers

The boilers were erected by the builders while the stokers were put in by the company forces under the direction of the contractor's superintendent. That no time might be lost in the construction, the boiler builders contracted with the steel erector to unload and place the heavy parts on the main boiler-room floor. The contractor used a large guyed derrick which easily handled the twelve headers and twenty-four drums, placing them approximately where they were to be erected, as is shown in the illustrations.

latter part of January and that the most severe weather in this part of the country occurred during February and March, this forms a remarkable record.

The following table gives in detail, the cost and the time required for the erection of the boilers and superheaters:

BOILERS		
Foreman, 81 days at $5	$405.00	
Labor, 8936 hours at $0.25	2234.00	
Total		$2639.00
SUPERHEATERS		
Foreman, 41 days	$205.00	
Labor, 2145 hours at $0.25	536.25	
Total		741.25
Grand total		$3380.25

As there were skilled men among the laborers used in the erection of the boilers and the superheaters, the

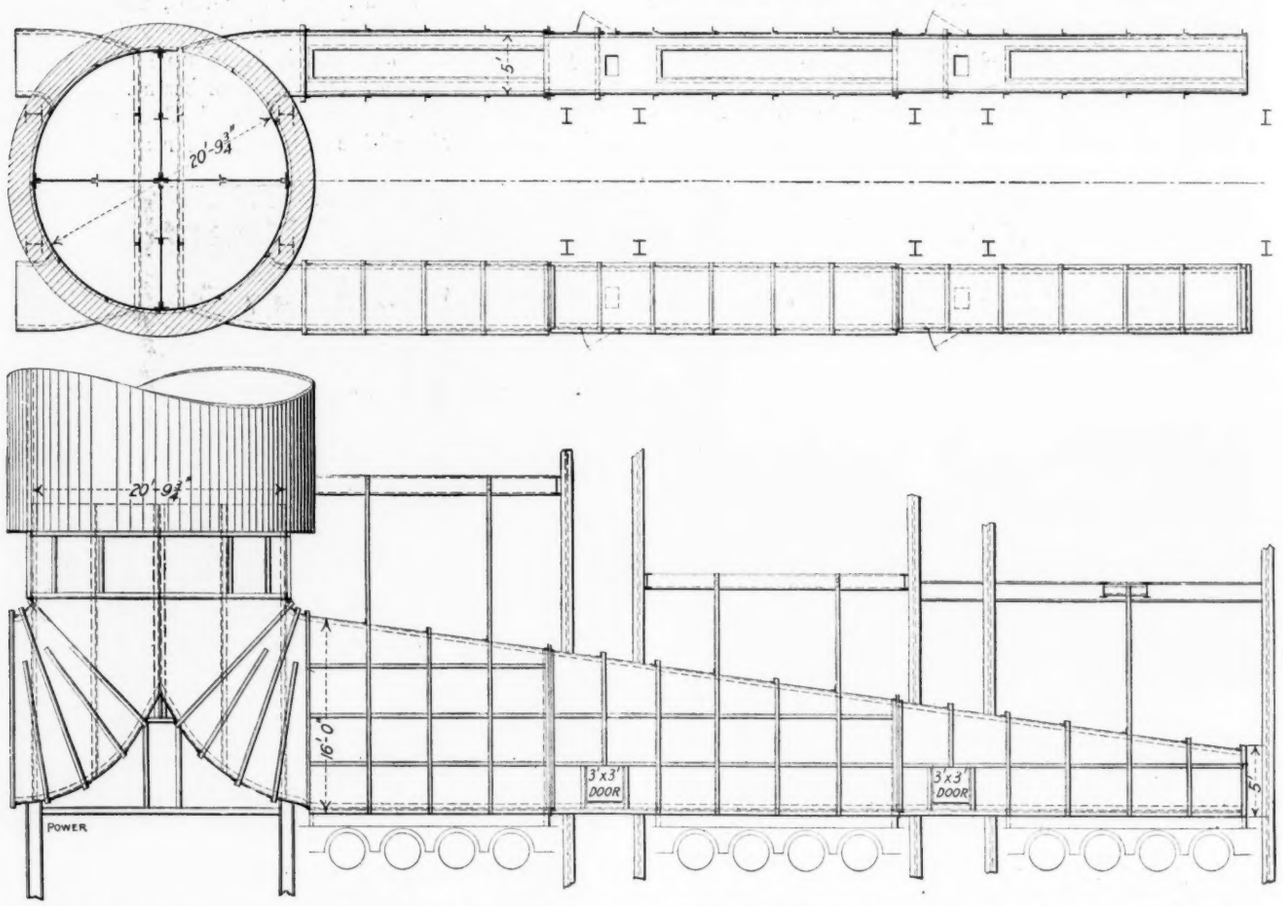


Fig. 3. Layout of Breechings (One Side) with Principal Dimensions for Six 1000-Hp. Boilers

Four cars of this material arrived on Jan. 27, two of which were unloaded on the 28 and two on Jan. 30. The unloading and placing were accomplished at a much lower cost to the boiler contractor than would otherwise have been the case, and with a minimum of interference with the work of other contractors.

The erection of boilers began on Feb. 2, and was finished on May 7, with the exception of certain minor details and alterations which were made later, making a total of about fourteen weeks, including the erection of the superheaters. The actual working time, including May 7, amounted to eighty-one working days.

Forty-one actual working days were required for the erection of the superheaters, which included seven days during which the foreman alone was on the job.

When it is considered that this work was begun the hourly rate of 25c. has been assumed as an average covering both common and skilled labor.

Brick Settings

Each setting required about 54,000 bricks. The laying contract was made with a local contractor, the company agreeing to furnish all brick and material for mortar, the brick to be delivered on the main boiler-room floor.

Actual brick laying began on Apr. 7, 1914, and the entire work was completed on June 6, about five weeks after the erection of the boilers.

The following is the actual labor cost of this portion of the work:

Foreman, 51 days at $6	$306
Bricklayers, 2560 hours at $0.62½	1600
Laborers, 2368 hours at $0.25	592
Total labor cost	$2498

This is equal to $7.70 per thousand bricks.

Unfortunately, owing to the delay in the erection of the coal-handling apparatus and breeching, the boilers were not placed in service until Aug. 17, 1914, although fires were started in three of them on July 29, in order to dry the settings.

Stoker Installation

Unloading and erecting the stokers began Mar. 6, 1914, and they were ready to turn over early in July. The installation of the six stokers, together with four fans, four engines and the necessary shafting and hangers, required the services of an expert erector for 127 days, with labor assistance amounting to 50 days.

Lemb System of Boiler Setting

The chief disadvantage of the general method of bricking in boilers is the breaking of the brick headers after the furnace lining begins to burn away, allowing the lining to bulge and sag.

The Lemb system of boiler setting is designed to do away with the drawbacks of the ordinary boiler setting. The setting consists of interlocking and ship-lapped dry firebrick and block lining, interchangeable fire-door and back connection arches, etc., held in place by protected binders. Figs. 1 and 2 give an idea of how a horizontal return-tubular and a water-tube boiler are set in accordance with the system.

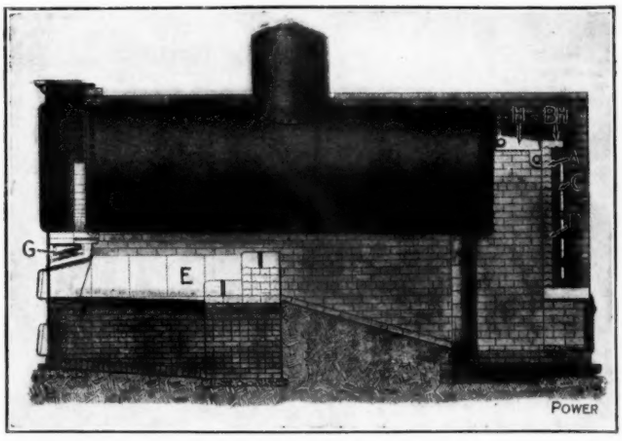


Fig. 1. Horizontal Tubular Boiler Set According to the Lemb System of Boiler Setting

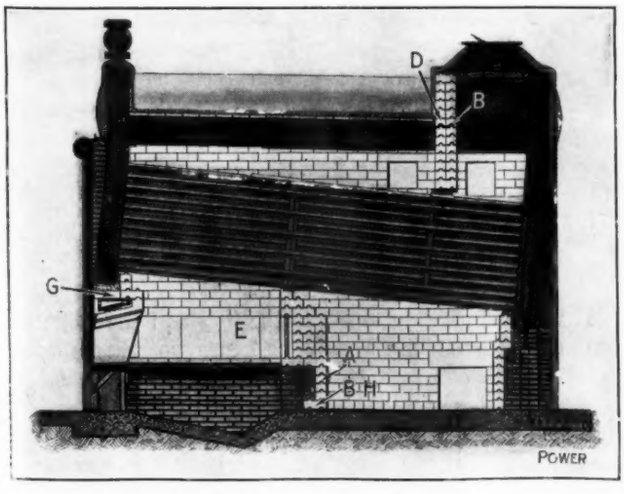


Fig. 2. Water-Tube Boiler Set According to the Lemb System of Boiler Setting

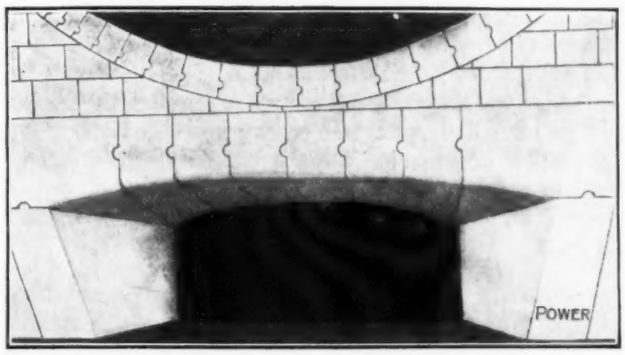


Fig. 3. Interchangeable Fire-Door Arch

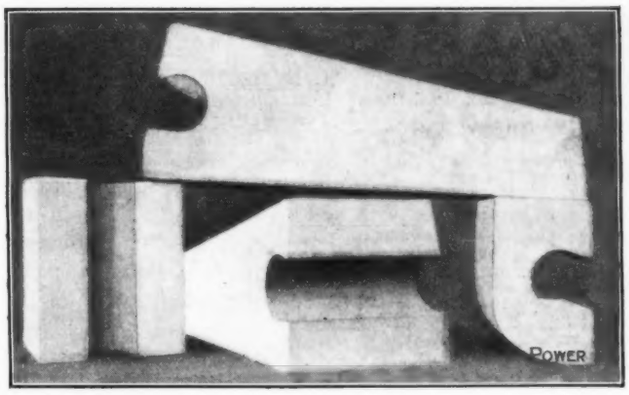


Fig. 4. Arch Block of the Back Connection Arch for Horizontal Tubular Boilers

Referring to Figs. 1 and 2, *A* shows the stretcher bricks and *B* and *BH* in combination with the binders form the headers; *C* is the binder for single walls and *D* that for party and baffle walls. The single-wall binders are anchored a full foot into the common wall; the binders for the party walls suit all thicknesses of walls. The firebox blocks *E*, made on the same principle as the brick, are 4½, 6 and 9 in. thick and 12, 18 and 24 in. high. The bricks, 3¼ in., are thicker than the standard firebrick; the width and length are the same as in the ordinary brick.

In the installation of this system, six stretcher courses are used between the header or binder courses. This brings them 2 ft. apart and makes the lining sectional, so that any one part can be removed or repaired without disturbing or interfering with any other part or section.

The burning-out sections of the firebox have a double lining, the furnace side being removable and of brick or block as conditions may require. Inasmuch as the brick and block are set dry, there is no settling. As the joints are knife-tight, but little clinkers will adhere; the linings are always fairly smooth. Owing to the strong tie caused by the binders, there is no bulging, sagging, or brick slipping out of place and there are no binders to break off.

The interchangeable fire-door-arch system, Fig. 3, consists of a series of sectional cast-iron, air-cooled arch plates, bolted to the boiler front. Movable hangers are suspended from the under side and interlocking arch blocks are placed on them; the hanger jambs and piers are similarly held in place. When the jambs, piers or arch blocks require renewal, the old blocks are pulled out and new ones slipped in. This is done without disturb-

ing the brickwork above the arch plates. The dead plate can be removed at any time without its interfering with the arch system, which is independent of the dead plate or boiler walls.

The interchangeable back connection arch system, Fig. 4, consists of fire blocks supported by standard piping held in place by the boiler side walls. These pipes permit of air circulation and are protected from the hot gases.

The blocks conform as nearly as possible to the natural courses of the gases and are smooth. With this type of back connection arch, one or more of the sectional arch blocks can be removed. They are set without fire clay and so arranged that they cannot leak air. This back arch is also independent of the main boiler walls.

This system is controlled and the parts for it are made by John Lemb & Sons, Inc., 177-179 Marion St., Brooklyn, N. Y.

Broken Baffles

By Morgan B. Smith

SYNOPSIS—A hole in the first baffle of a Stirling boiler cut down capacity, lowered the efficiency from 78.8 to 28.2 per cent., and raised the temperature of gases leaving the boiler by about 350 deg. F.

The boiler which was examined, and in which a broken baffle was detected, is a 500-hp. Stirling, baffled in the usual manner. It is fitted with a steam-flow meter and electric pyrometers in the combustion chamber (top) and in the top of the last pass. It was the indications of the flow meter and the pyrometer in the last pass which gave rise to the thought that one or more of the baffles must be broken.

For some time the flow meter had indicated a sluggishness of steam generation which did not greatly improve with hard-driven fires. At the same time the temperatures of the gases passing to the stack, or breeching, had risen, on the average, something like 350 deg. F.

Before shutting down this boiler for repairs it was thought best to get together data bearing on its peculiar behavior. Consequently, readings of the steam produced and the temperatures in the top of the last pass, as well as over fires, were taken for a period of four days.

As the general figures for this boiler were known, those obtained at this time, with the boiler obviously in bad condition, could be compared with those found under normal conditions. After obtaining these figures the boiler was cooled down and examined.

The front baffle, possibly the most important of all three in this type of boiler, was found to have a hole in it 32x28 in. in size. This hole was irregular in shape and broader at the bottom than at the top.

The edges of the baffle brick around the hole were badly fused, so much so that they were rounded and there was some indication of actual fluxing. This, without a doubt, was caused by the intense concentration of heat as the products of combustion swept through this comparatively small opening. It is obvious that had the boiler remained on the line much longer serious tube trouble would have developed at this point.

The results of such a broken baffle are, in general, diminished capacity, since contact of the heated gases with the tubes is greatly lessened; distortion of the tubes in the immediate neighborhood of the break, with possible ultimate failure; diminished efficiency of combustion; disturbed circulation and, probably, foaming. Fig. 1 shows graphically the working conditions of this boiler, especially the temperatures found at the top of the combustion chamber and in the top of the last pass.

The average temperature over the fire is 2462 deg. F.; at the top of the first pass, 1148 deg. F., and at the top of the last pass, 545 deg. F.

Fig. 2 shows the change in conditions after the breaking of the front baffle. The rise in temperature at the top of the last pass explains at once the falling off in the evaporation in this boiler. The fire was maintained as closely as possible at the average temperature generally maintained in this furnace, viz., 2462 deg. F.

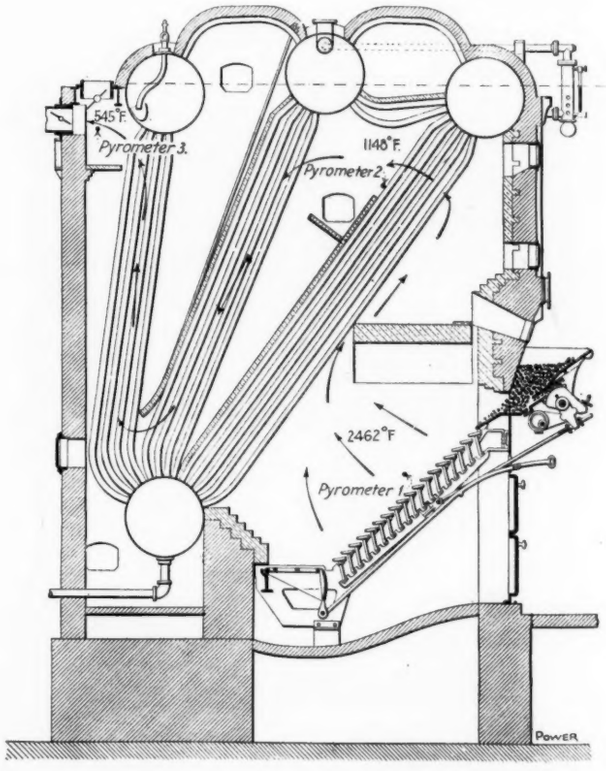


Fig. 1. Normal Working Conditions in the Boiler Investigated

It was not possible to locate the break in the baffle before shutting down the boiler; hence no temperatures could be taken at the point of rupture in the baffle. It is probable, however, that the temperature at this point did not fall much from that in the furnace since the contact with the tubes in the front bank was limited.

The temperature was estimated, considering the known softening point of the baffle brick, at close to 2372 deg. F.

Considering the short cut which the gases took through

the tubes it is remarkable that the temperature in the top of the last pass was not higher than found, viz., 1778 deg. F.

Summarizing the temperatures found in normal practice and those found under conditions imposed by the broken baffle, we have:

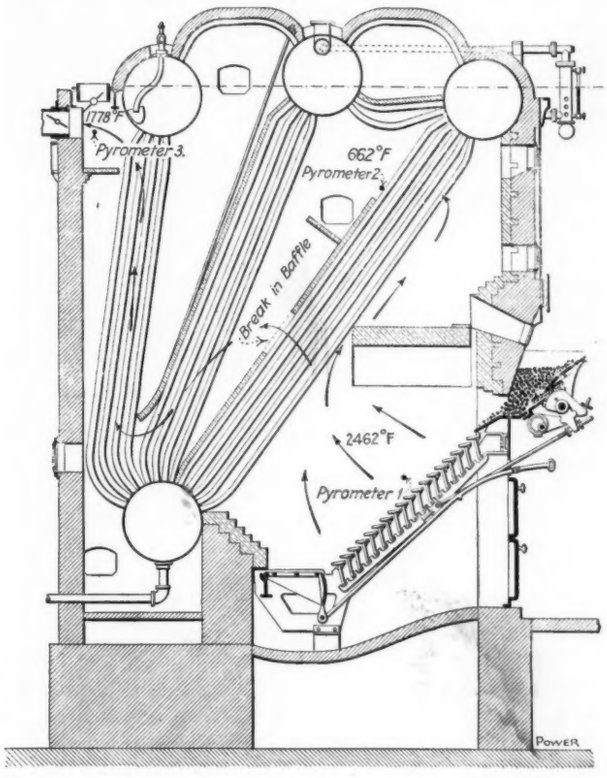


FIG. 2. SHOWING BREAK IN BAFFLE AND RESULTING TEMPERATURE CONDITIONS

TEMPERATURES IN DEG. F.

	Pyrometer No. 1 Over fires	Pyrometer No. 2 Top of first pass	Pyrometer No. 3 Top of last pass
Normal	2462	1148	545
Abnormal	2462	662	1778

HEAT ABSORBED

Normal conditions: In first pass, 54 per cent. First to third pass, inclusive, 24.7 per cent. Total heat absorbed, 78.8 per cent.

Abnormal conditions: In first pass—doubtful. Total heat absorbed, 28.2 per cent.

The loss in evaporative effect in this boiler, due to the broken baffle, was, therefore, roughly in proportion to the heat absorbed or the difference between the temperatures observed at the top of the last pass, the ratio being 545:1778. Thus, the boiler after the rupture of the baffle showed less than one-third the efficiency it had shown under normal conditions. These figures were checked by the readings of the steam-flow meter.

The point is that efficiency is at once lowered, often seriously, when the products of combustion, heated gases, are allowed to pass through the heat-absorbing surfaces without proper contact. The installation of pyrometers in the top of the last pass, fitted with recording devices, if possible, is a ready safeguard against operating for any length of time with baffles out of order.

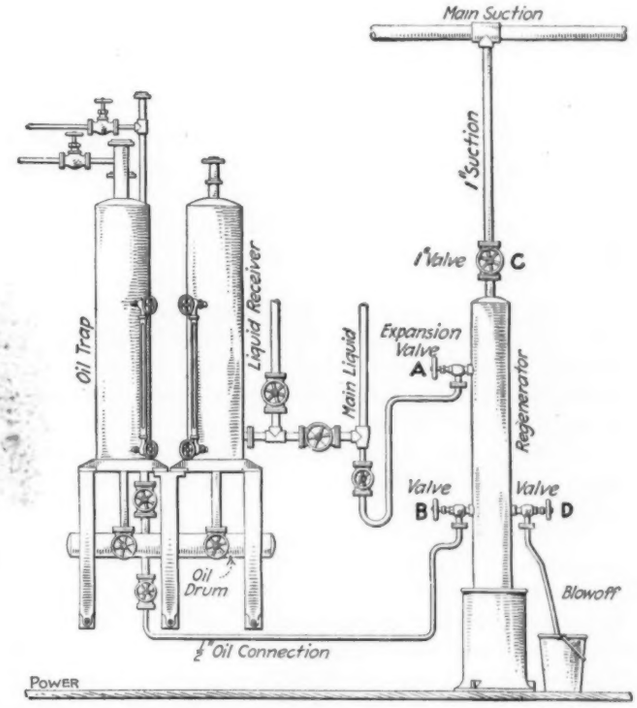
The case here described is possibly a somewhat exaggerated one, but serves to illustrate the importance of the topic under discussion. What is true of this particular boiler is also true of other types in which baffling is employed in order that the contact of the gases with the heat-absorbing surfaces may be kept at a maximum.

Baffles should be examined every time the boiler is down for cleaning and the smallest cracks found should at once be cemented tightly; it is at these small openings that heat, concentrating, gradually forces a larger and larger opening until failure of the baffle is the result.

Pyrometer tests are easily made; the apparatus required is not expensive and the time required is practically *nil*—therefore, watch your baffles.

Vilter Ammonia Regenerator

The Vilter Manufacturing Co., Milwaukee, Wis., has recently placed on the market an ammonia regenerator to be used for keeping the charge of ammonia in the system in an anhydrous condition. The regenerator is connected to the liquid side of the system instead of to the suction side, and the impure ammonia is supplied to it and cleaned from its impurities by a process of evaporation.



THE VILTER AMMONIA REGENERATOR

Referring to the illustration, the liquid ammonia with its impurities comes to the regenerator from the liquid receiver, oil drum or ammonia condenser to the valves *A* or *B*.

On entering the evaporating drum, the ammonia is relieved of the pressure which held it in a liquefied state and expands into a gaseous form. The vapor passes out of the drum through the valve *C*, connected to the nearest suction line by a one-inch pipe. To accelerate the vaporization of the liquid ammonia, a water jacket is provided, the water being taken from a feed-water heater or other source whose temperature is from 150 to 180 deg. F. If desired, a small steam pipe may be connected to the water jacket. The jacket is internal to the drum, an

internal heating coil or pipe being avoided to obviate the possibility of damage due to bursting of the heating pipe through freezing of the water in it.

The interior of the shell has a cast-iron distributing plate circumferentially perforated and placed immediately below the inlet *A;* this plate acts much the same as that in a puddle carburetor. In operation, the outlet valve *C* is opened wide, all other valves being closed. The water to the jacket is then turned on, after which the expansion cock *A* is opened slightly. The drum will now commence to frost, and the cock *A* may be slowly opened wider to increase the flow of liquid until the upper part of the drum becomes frosted. Care should be taken that the frost does not continue along the suction pipe past the valve *A*. This may be controlled by manipulating the expansion cock.

After about twenty-four hours' operation, the valve *A* should be closed until the frost has disappeared from the drum, after which the valve *B* should be closed tight. The blowoff valve is now opened, and the impurities or residue from the ammonia is drained from the drum. If the ammonia is very impure, it will, of course, require more than twenty-four hours to take out all of these impurities.

All the connections are shown in the illustration.

Some Common Elevator Troubles

By Albert H. Israel

SYNOPSIS—Besides the many electrical troubles met in caring for electric elevators there are also numerous mechanical ones. The most important of these are considered. The article is timely, due to the workmen's compensation laws now in force in many states.

Testing the Safeties

When the speed exceeds a limit set by the building or other department of the municipality, the governor and the safety device which it is supposed to operate are of little use if the governor has not been adjusted properly. There are governors which will not even rise at the desired maximum speed.

The safety device under the car, the guides, the governor with all its parts, and the governor rope are surely most important, for the safety of the passengers depends upon these parts being in good condition. Often the gripping cams will hug the governor rope when the car overspeeds but they will not grip it; then the gripping faces of the cams should be filed to the right shape or the cams renewed. For this reason, when making a runaway test one should not be satisfied with merely seeing the cams beginning to hug the governor rope when the speed of the car is near the maximum allowed; one should see the safety brake actually thrown in when the permitted speed has been reached. Runaway tests are not beneficial to the elevator mechanism, especially to the guides, and frequently they require considerable scraping after a test.

Usually, the easiest way of ascertaining the speed of the car is to make a heavy chalk mark on the winding drum at a certain point and then, by means of a good stopwatch, get the number of seconds it takes to make a definite number of turns of as nearly constant speed as is obtainable. The speed is found from the equation

$$S = \frac{R \times C \times 60}{T}$$

where

R = Revolutions of drum;
C = Circumference of drum in feet;
T = Time in seconds in which revolutions of drum were made;
S = Speed of car in feet per minute.

It is well to place a metal guard over the sheave to prevent the governor rope jumping off and breaking parts of the governor or injuring the rope after the governor has acted.

Wherever an idler pulley is required under the car for the governor cable it should be securely fastened, otherwise when the governor acts it may fall to the bottom of the shaft or injure the rope.

The law generally requires that there be two and one-half turns of governor cable on the safety drum when the safety has gripped the guides, but since the adjustment may change somewhat, one should unwind the cable at regular intervals to ascertain if there are at least this many turns. The reason for this law is to make certain that the safety will grip when the governor acts.

Care of the Band Brake and Counterweights

It should be needless to say that the unusual wearing of the ropes is sometimes caused by their rubbing against some surface in the shaft. This fault should be easily discovered by an examination of the cable and the shaft.

When the band brake has been removed for any reason and is put back into place, one should make sure that it has not been bent out of shape. If it is, it may bear hard in some places even though it may seem entirely free of the pulley and so cause the motor to draw an excessive current.

The ropes to the lower counterweights, unless properly protected by tubing, may wear where they pass through the upper counterweights. The tubes should be long enough and clamped to the lower counterweights; if allowed to remain loose, they may themselves prove dangerous to the rope.

Each set of counterweights should always be securely bolted together. In old installations where this has not been done, they should be strapped together with strong iron bands. The importance of this will be seen if we imagine the car stopped suddenly near the bottom of the shaft by the safety, and, due to the sudden shock, some weights are shaken off and dropped down the shaft onto, and perhaps through, the roof of the car.

Bent and Worn Guide Shoes

Now and then the guide shoes will be found too loose or too tight, out of line or broken or worn to such an extent that they require replacing. A broken shoe-spring may be the cause of the looseness. When the spindles of

the shoes are found bent it may generally be shown that the car has run into the overhead work or struck bottom at some time or other. When the upper shoes are bent from this cause, the grating is frequently bent upward.

The guides frequently become troublesome through no fault of their own, especially if they are insufficiently lubricated or if a bent shoe starts scraping. When first installed, they should have the proper strength and be securely fastened to the girders; if this is not done, there may be a considerable wreck when the first runaway test is made by the building department inspectors.

A loose grating at the top of the shaft is not an uncommon source of danger to the passengers, the operator and to those whose duty it is to examine the overhead work. Since it is so easily remedied, a loose grating should never be allowed to continue.

The latches on ordinary doors are a source of peril to inquisitive people. When the latch is so worn that it will no longer lock properly, persons are likely to look into the hatchway with the all too often fatal result. A person who is ignorant enough to put his head through a hole in a door to see whether the car is coming will surely not hesitate to open the door if he can.

Proper oiling of the various parts is essential whether the parts in contact are frequently in motion or not. A part not oiled will sometimes rust until it becomes immovable. This is particularly so of those belonging to the governor mechanism and the safety drum under the car. The lack of oil on the latter, together with the water allowed to seep through a nonwaterproof floor, will in most cases produce corrosion of the machinery. The writer recalls one occasion where a worm-gear shaft bearing was allowed to become so hot at the rear end, due to the lack of oil in the gear case, that the bearing metal "froze" to the shaft when the machine stopped.

Systematic inspections at regular intervals by reputable insurance companies should always be welcome. The professional inspector will find troubles which would probably remain undiscovered for a long time if the inspections were left to the house force alone.

Will Quiz, Jr.

SYNOPSIS—Will Quiz, Jr., wants to verify Chief Teller's statement in a previous chat to the effect that the boiler is a more efficient machine than the engine, and, true to his nature, asks more questions.

"One statement you made lately seems strange to me."

"What was that, Will?"

"You said the boiler was a more efficient piece of apparatus than the engine; can you show me?"

"That's right, Will; take as little as possible for granted; there are some things which must be taken on statement for the time being, but they should be looked into and proved or disproved later.

"Let's see, we found that 14,070 B.t.u. coal theoretically should evaporate, from and at 212 deg., 14.5 lb. of water per pound of coal. What is the best boiler-test evaporation you can remember just now, Will?"

"It seems to me it was nearly 12 lb.; 11.6 would be equal to 80 per cent. efficiency, would it not?"

"Yes; but 80 per cent. is high for everyday practice. Suppose we use about 9.5 lb. evaporation, which would be about 65 per cent., or, expressing it in the same way that we did in the first instance, where the actual heat energy in a pound of coal is equal to 5.5 hp. for an hour, the heat energy delivered in the form of steam by the boiler at 65 per cent. efficiency is equal to about 3.5 hp.-hr. Now, how does the engine use the heat sent to it? Suppose the engine uses 19 lb. of steam per horsepower-hour, or twice 9.5 lb., the boiler's output in evaporation per pound of coal, or twice the 3.5 hp-hr. referred to. Then the engine gets enough heat energy to produce 7 hp. for an hour and only delivers one—i.e., 2 lb. of coal, or

$$14{,}070 \times 2 \times 0.65 = 18{,}291 \textit{ B.t.u.} \times 778$$

(the mechanical equivalent) divided by 1,980,000 ft.-lb. per hp.-hr = 7. In other words, the engine requires seven times the heat it should, or is about 14.3 per cent. efficient. The best engines only transform about 20 per cent. of the heat energy supplied to them into work, and many do no better than 4 or 5 per cent. The steam engine, in fact, all kinds of engines, are simply heat motors, and the loss in the heat contained in the fluid in passing through as compared with the power output is the measure of efficiency.

"Since 2545 B.t.u. equals 1 hp-hr., that is the amount chargeable to useful work, and all the rest is wasted in friction, radiation and the exhaust steam."

"But, Chief, the difference in the total heat in 19 lb. of steam at the different pressures by the table does not allow enough B.t.u. for a horsepower-hour."

"No, it is the latent heat in that part of the steam which has returned to water, or the degree of wetness of the exhaust steam, which accounts for the B.t.u. used. In the case cited of 19 lb. of steam per horsepower-hour, you would find about 2¾ lb. of steam had given up its latent heat and become water. This gives the same result as before—that is, a little over 14 per cent. efficiency for the engine; 14.3 per cent. of 19 = 2.72 lb."

"But, Chief, suppose the exhaust steam is used for heating buildings; then the engine would not be charged with the heat in the exhaust steam and its efficiency would be called 85.7 per cent."

"Yes, Will, looking at it that way it is good, and I am glad you caught that point, because if the exhaust is made use of for heating or other useful work, not simply condensed, then the engine is not to be charged with more than the heat actually lost in it, which, as you have seen, is not much in excess of the energy reproduced in the form of work. But the boiler is charged with all the heat wasted in producing steam, including the waste in the stack gas, so for comparison the engine as a unit must be charged with all the heat delivered to it."

Front-Feed Stokers*

By Osborn Monnett†

SYNOPSIS—How this type of stoker should be set under return-tubular and water-tube boilers. Full instructions for smokeless operation.

Under this classification come all stokers of the inclined type fitting in at the front of the boiler and having a shaking or dumping grate at the bottom near the bridge-wall. One of the principal points in its design is not to get the angle of inclination great enough to cause avalanching of the coal and at the same time have the angle sufficient so that the fuel will feed freely without having to be pushed in by hand from the front.

Moore Stoker

This consists of a series of cast-iron steps at a general angle of about 37½ deg. Water circulation, passing from

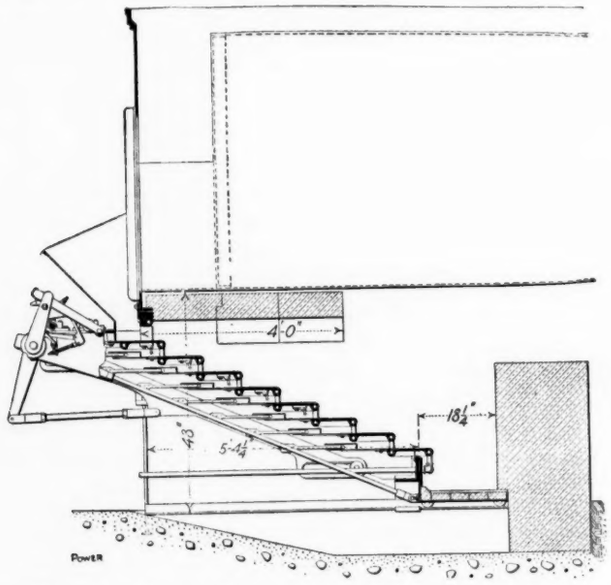


Fig. 1. Moore Stoker under Return-Tubular Boiler

the lowest step upward in regular order to the top step and then to the gate, is provided. In between the cast-iron water-cooled steps are pushers made to withstand the action of the heat. Normally they rest at a point not subjected to high temperature and are only in the fire long enough to push the coal from one step to another, according to the demand for steam.

The dumping arrangement consists of a cast-iron fire-brick-lined carrier on wheels, which can be pulled out from in front by a hand lever. The operation is simple and no cleaning is required, the clinker, if any, forming in the shape of small lumps the size of a man's fist and dropping into the ashpit.

When installing this stoker under a horizontal return-tubular boiler, the chief requisite is to have sufficient headroom for an ignition arch over the grate. The stoker is set flush front and 48 in. is all that is required for a 72-in. by 18-ft. boiler. This unusually low headroom gives the stoker certain advantages when applied to settings limited in height or to existing hand-fired plants set too low for good hand-fired furnace design. In the case of laundries or dye houses, the hot water from the stoker can be used to advantage in the manufacturing processes, while in other cases it is available for feed water. The stoker eliminates the human ele-

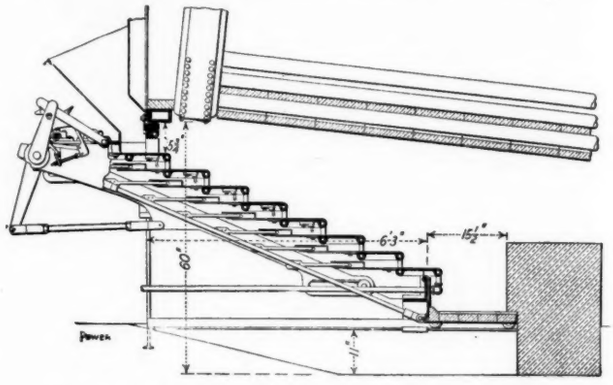


Fig. 2. Moore Stoker under Heine Boiler

ment to a large extent. It requires no poking and the cleaning period consists of dumping the ash from time to time. Fig. 1 shows an installation under a return-tubular boiler. The high bridge-wall has as good an effect on the performance of the stoker as with the chain grate or a hand-fired furnace. Limitation to the height of the bridge-wall is the necessity of leaving above it an area not less than 25 per cent. of the grate surface.

Fig. 2 shows a Moore stoker applied to a horizontally baffled water-tube boiler of 175-hp. capacity. The grate surface is 40½ sq.ft. and from the floor line to the bottom of the front header the distance is 60 in. The box tiles on the water tubes act as the ignition arch and give

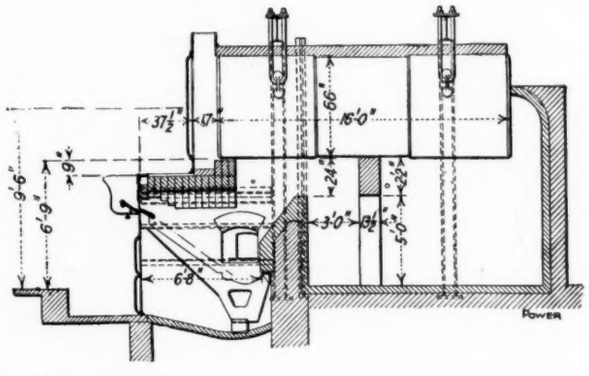


Fig. 3. Return-Tubular Boiler Equipped with Roney Stoker and Deflection Arch

enough flame travel to mix the gases. The stoker can be placed under any water-tube boiler and the low headroom maintained if the boiler is horizontally baffled. An installation under a vertically baffled boiler should not be attempted without a long ignition arch sprung over the furnace and a headroom of at least 9 ft. 6 in. under the front header.

*Copyright, 1914, by Osborn Monnett.
†Smoke Inspector, City of Chicago.

Feed ashes into the hopper until the grates are covered and start a fire at the grate with oily waste or with live coals from another furnace. When the coal or waste has ignited, feed the stoker slowly by hand until a good bed of fuel is on the grates. Then open the damper and let the engine run the stoker in the usual way. When ashes accumulate on the dump grate, pull out the lever provided for the purpose of dropping them into the ash-

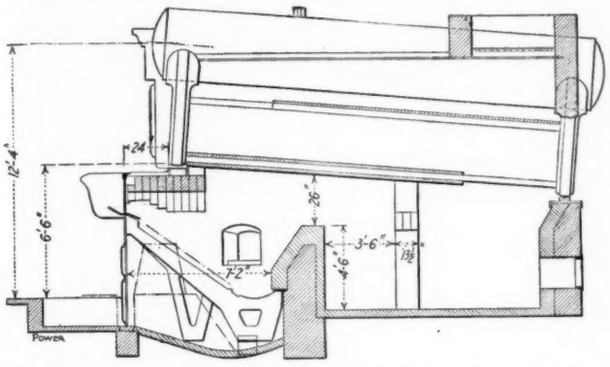


FIG. 4. RONEY STOKER AND TWO-SPAN DEFLECTION ARCH UNDER 185-HP. KROESCHELL BOILER

pit. Regulate the speed of the engine in accordance with the demand for steam and keep the grates as nearly covered as possible. There is no cleaning period for this stoker and no necessity for working it from the sides. To make it smoke-proof, the damper should not be closed when any considerable quantity of fresh coal is on the grates.

BANKING AND BREAKING UP FIRE

Feed in a considerable quantity of coal rapidly with the hand lever. Close the damper and leave the water circulation on the grates.

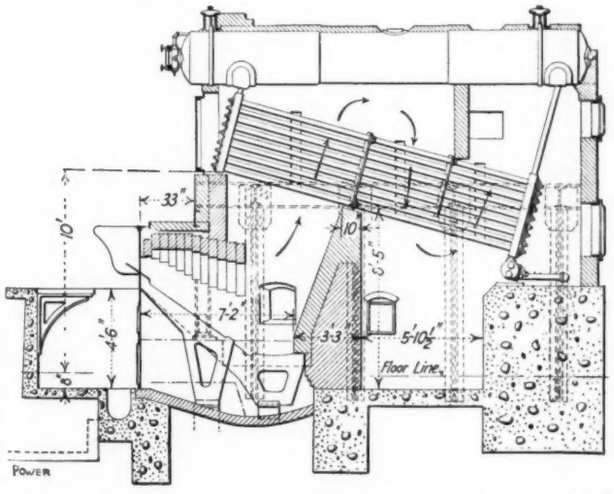


FIG. 5. RONEY STOKER AND VERTICALLY BAFFLED B. & W. BOILER

When breaking up the fire, open the damper and wait until the fuel has properly ignited before regular operation is resumed. When starting the fire on a Moore stoker, always be sure that the water circulation is turned on and have the outlet in such a position that the overflow can be seen at a glance by the fireman.

RONEY STOKERS

A Roney stoker under a return-tubular boiler is shown in Fig. 3. The headroom is that required to get in the ignition arch under the shell of the boiler. This can usually be done on 72 in. when it is possible to excavate the ashpit to some extent. In the particular instance shown in Fig. 3, the headroom is 81 in., due to the relieving arch. In operating this stoker, there are times when an excessive amount of volatile matter is likely to be driven off. A successful safeguard in taking care of these periods is shown in Fig. 3 in the form of a two-span deflection arch behind the bridge-wall. This breaks up the gases and has been a great help in running such a setting clean.

In applying the Roney stoker to water-tube boilers it is generally safer to use the horizontal baffle in cases where the smoke question is of prime importance. Fig. 4 indicates a typical installation of this stoker under a Kroeschell boiler, set 6 ft. 6 in. from the floor line to the front header, with an excavated ashpit. Behind the bridge-wall is a two-span deflection arch with an area under the arch equal to 50 per cent. of the grate surface.

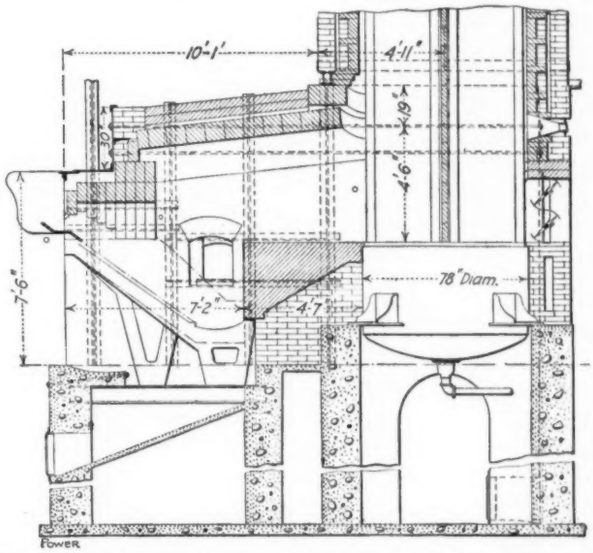


FIG. 6. WICKES VERTICAL BOILER, 250 HP., SERVED BY RONEY STOKER

With vertically baffled water-tube boilers the prime necessity is flame travel. This can be obtained only by setting the boiler high enough so that combustion will be completed before the gases enter the bank of tubes. Fig. 5 gives the details of such a setting. The boiler is of the B. & W. type, set 10 ft. above the floor. This should be the minimum headroom allowed for this type of boiler. Set in this way, with good bridge-wall design, the flame travel is sufficient to give good results.

In the case of vertical boilers, it is a simple matter to apply the Roney stoker and get all the flame travel necessary. Fig. 6 shows a typical illustration of the stoker under a Wickes boiler. In this installation the high vertical bridge-wall reflecting its intense heat onto the grates is an important factor in smokeless operation. Also, it provides an obstruction against which the gases must impinge before passing to the heating surface, so that a more thorough mixture of the gases is obtained. This is of special importance when an excessive amount of volatile matter is passing off.

HOW TO OPERATE A RONEY STOKER

After the grate has been covered with coal and a fresh wood fire started on top of the fuel, open the damper

partly until the fuel has been completely ignited. Then the damper can be opened wide and the stoker fed slowly until the arch is heated up. As in chain-grate operation, the grates should be kept as thoroughly covered with fuel as possible, considering the load, as cold air coming up through any part of the fuel bed will interfere with efficiency. This can be regulated by the frequency of the feed.

Cleaning Fires

First, pull up and fasten the rods that lift the guard grates. This will break the clinker free from the grates, permitting the refuse to drop into the ashpit when the dumping grates are tipped. The guard grates should be kept in the upper position until the dumping grates are closed, to prevent live coals on the lower grates from dropping into the ashpit. If a clinker should catch on a dumping grate, break it loose and pull it out with a hook, but do not disturb the fire on the upper grate. After the ashes have been dumped, close the dumping grates, then unhook the guard-grate rods and return them to their normal position. If the cleaning is done properly, there will be no necessity of poking the fire to cover the lower grates. Poking a Roney stoker is one of the most frequent causes of smoke.

Do not shake the guard grates in an effort to get out all of the clinker, because in so doing good coal will drop into the ashpit and the lower part of the grates will become uncovered. Only clean one furnace at a time and allow a considerable interval to elapse before working another fire.

Never work a fire through the side inspection doors, as this causes the coal to avalanch and produce smoke. Regulate the length of the fire by the speed of the stoker and do not poke between the bars from the front; this frequently causes a large part of the fire to slide down on the grates and a considerable quantity of fresh coal to be dumped suddenly into the fire, causing smoke. If a sudden demand for steam occurs, speed up the stoker. In case the steam pressure goes up, do not shut the ashpit doors but slow down the stoker to prevent popping. In case the steam pressure still goes up, stop the stoker entirely and after the volatile matter is burned off, carefully close the damper. Do not close the damper on a thick, heavy fire containing fresh coal, as smoke will be made. Always leave the ashpit doors and dampers wide open on a normal working load.

Planet Steam Soot Blower

A soot blower for return-tubular boilers, which is mounted on the flue-cap door and can be ope ated while the boiler is in operation, has been completed recently by the Bennett-Dluge Co., of Detroit, Mich.

The construction and arrangement are shown in Figs. 1 and 2. Primarily, the blower consists of a square telescoping arm provided with a number of steam jets. By means of gearing and a handwheel exterior to the boiler, the arm is moved across the face of the tubes. Its movement is guided by the cam track shown in Fig. 1, the path of the extreme jet being indicated by the dotted line. The blower is mounted in a bracket bolted to the door and through the supporting pipe steam is admitted to the arm. With the number of jets shown, all blowing at one time, one passage of the arm over the flue sheet

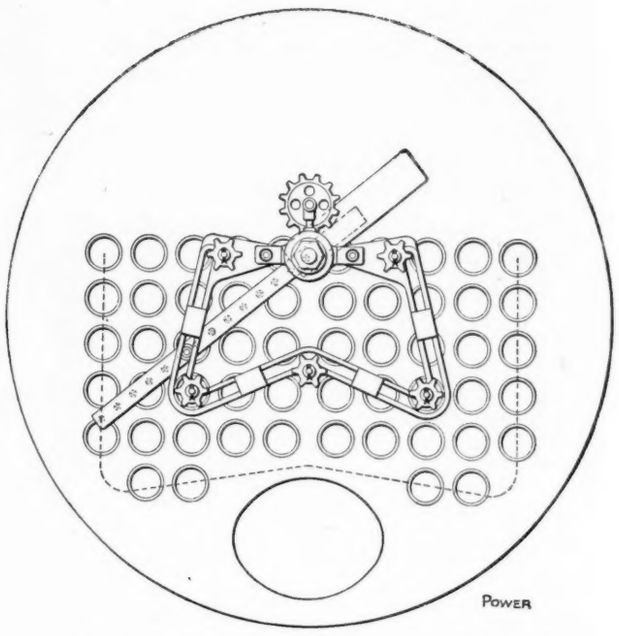


Fig. 1. Telescoping Arm and Cam Track

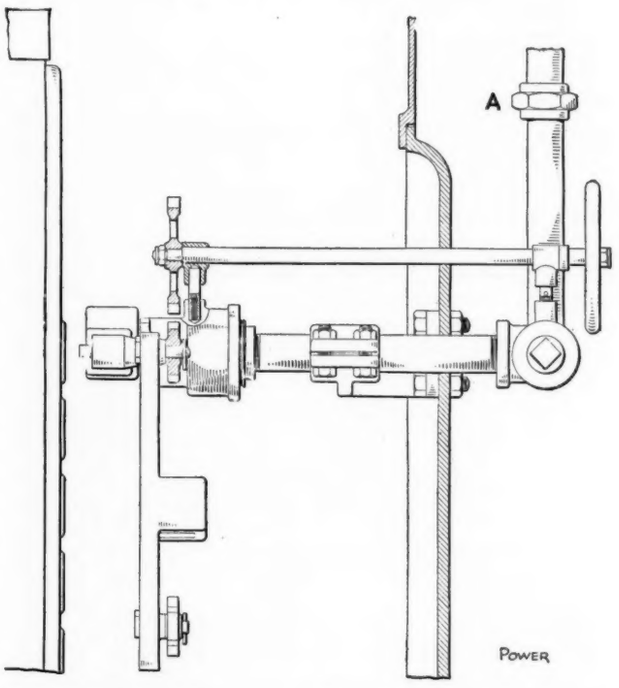


Fig. 2. Steam Jets on the Square Telescoping Arms

covers all of the tubes. As shown in Fig. 2, the jets are close to the flue sheet and blow into the tubes. Unscrewing the union at *A* allows the door and the blower to swing clear.

Stored Heat—In Germany a state dinner was to be given in a castle which had no heating system. The engineers were asked to heat the building for the dinner; but it was specified that no portion of the heating system was to be visible in the room. The result was accomplished by means of stored heat. For a number of days previous to the dinner, the floor of the dining room was covered with steam pipes and these pipes were kept hot by means of a temporary boiler. The day before the dinner all the pipes were removed and the stored heat in the walls maintained the room in a perfectly comfortable condition for a number of days, although the outside temperature was well below the freezing point.

Curves of the Properties of Saturated Steam

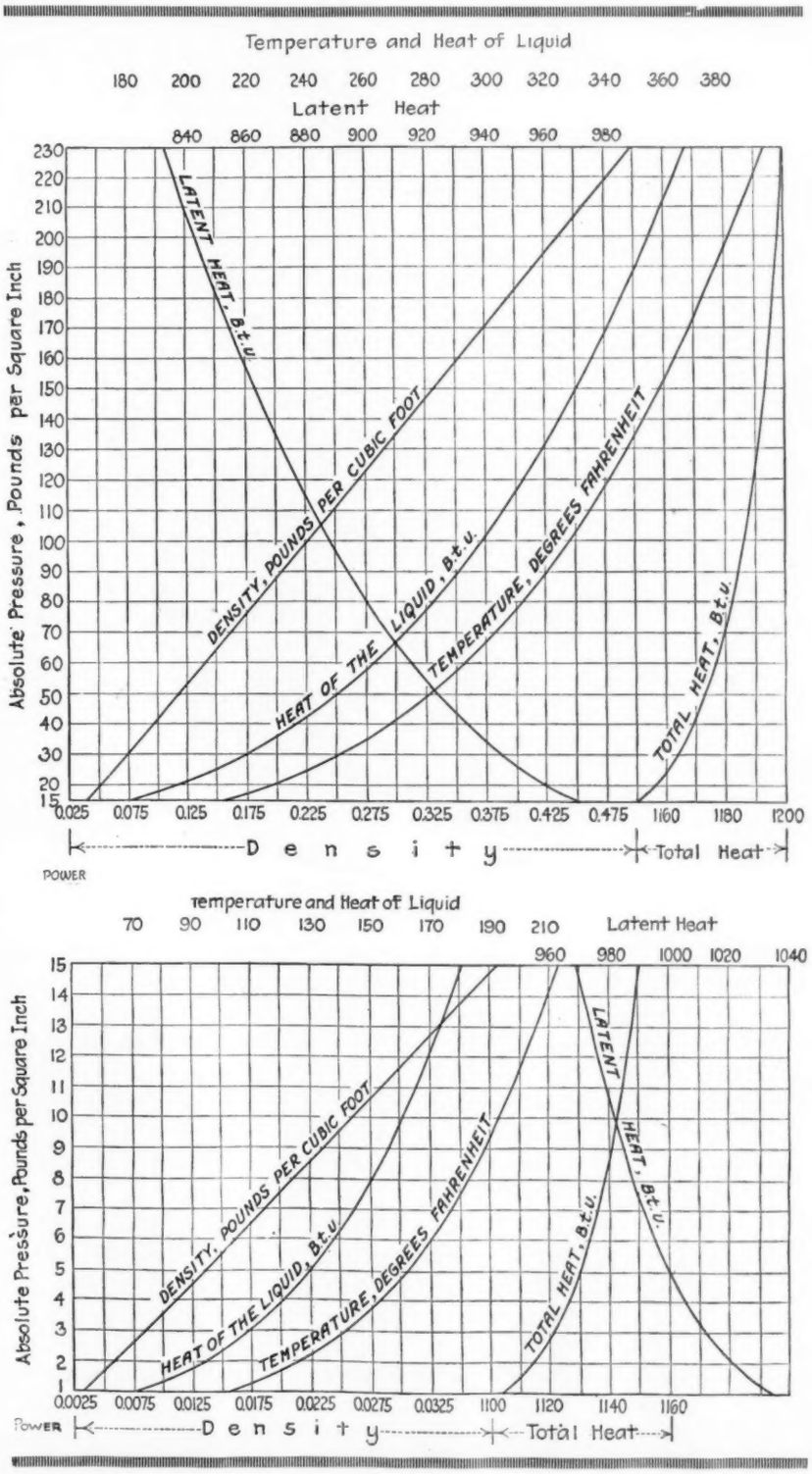
By Julian C. Smallwood

FOR certain classes of work, it is desirable to have approximate data upon the properties of steam, obtainable for rough calculations without the necessity of hunting up steam tables; for steam engineers, especially, a pocket reference giving such data is often as important an item of personal equipment as a slide rule. On this account the accompanying chart based on **"Marks and Davis Steam Tables"** has been carefully prepared.

By its use, the heat quantities may be read to the nearest unit; that is, to within one-half of one B.t.u. or degree F. for any pressure between one and 230 pounds absolute. The upper part of the chart deals with pressures above atmosphere, and the lower part, pressures below atmosphere.

To use the chart, find the given pressure on the left-hand scale, and follow the horizontal line at this pressure until it intersects the curve of the property sought; then follow vertically to the corresponding scale.

If temperature is given instead of pressure, use the temperature curve in place of the scale.



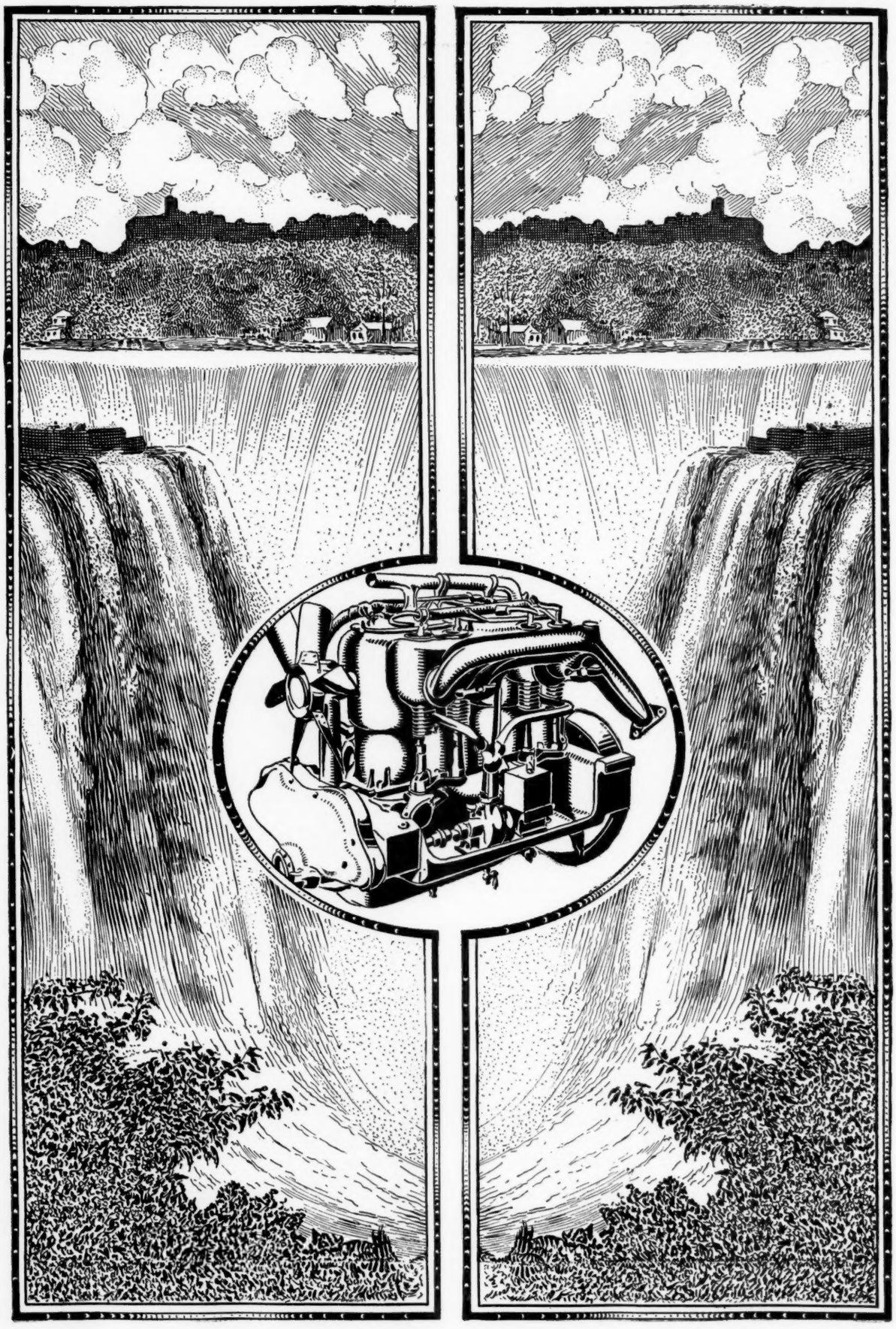
Example 1—Find the latent heat, density, temperature, heat of the liquid, and total heat of steam at 155 lb. absolute.

Solution—For 155 lb. it is necessary to interpolate between the 150 and 160-lb. lines. This would cross the latent heat curve between the ordinates 860 and 865 B.t.u., corresponding to about 861 B.t.u. Similarly, it would cross the density curve at 0.342, the temperature curve at 361 deg. F., the heat of liquid curve at 333 B.t.u., and the total heat curve at 1194 B.t.u.

Example 2—Find total heat in 1 lb. of steam at 193 deg. F.

Solution—As 193 deg. is below 212, which corresponds to atmospheric steam, we must look to the lower part of the chart covering pressures below atmosphere. The 193-deg. point is found on the temperature curve where it intersects the line of 10-lb. pressure. Following this pressure line horizontally to the total heat curve, we find 1143 B.t.u.

The properties of wet steam may be readily calculated when the percentage of moisture is known.



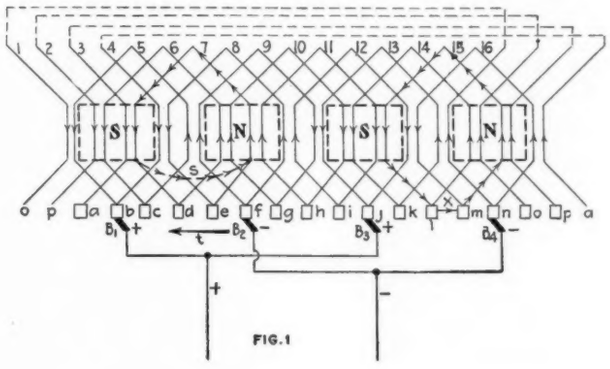
THE AGGREGATE POWER OF THE AUTOMOBILE ENGINES MANUFACTURED LAST YEAR IN THIS COUNTRY IS EQUIVALENT TO TWICE THE POTENTIAL POWER OF NIAGARA FALLS, OR 13,500,000 HORSEPOWER

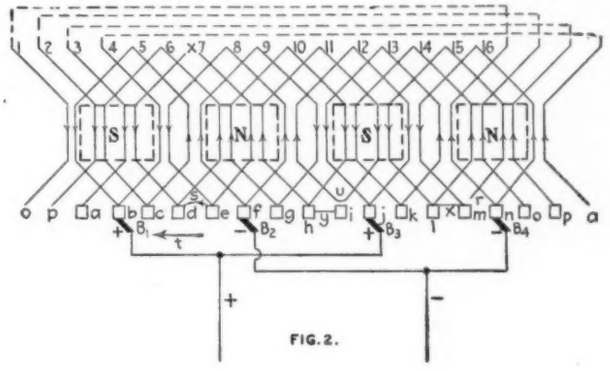
Locating Faults in Direct-Current Armatures--II

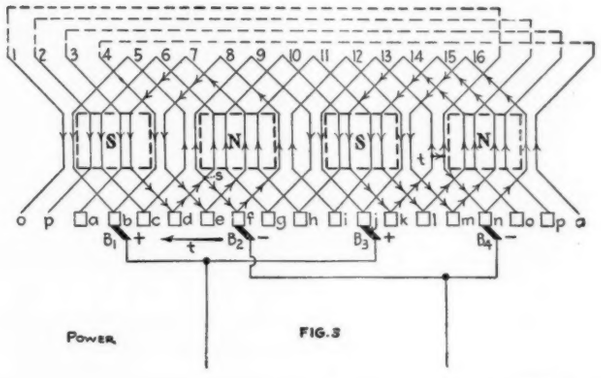
By F. A. Annett

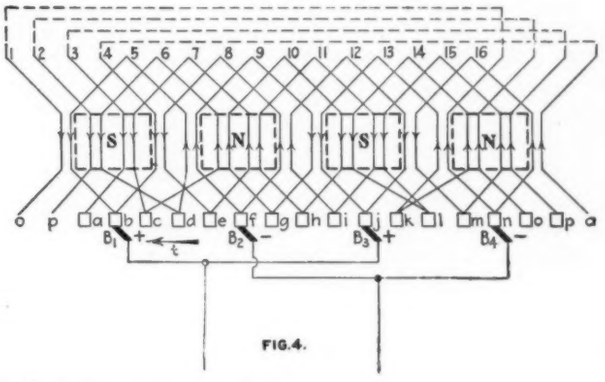
SYNOPSIS—Causes of short-circuits in armature coils, their symptoms and how repairs may be made.

A short-circuit in an armature may be caused in several ways: First, one or more turns of the same coil may come in contact with each other, as indicated by the dotted line *s*, Fig. 1. This, however, can occur only where the armature coils are wound with more than one turn. To eliminate complications in the diagram, the winding is shown with only one turn per coil, which is the case in large machines or those wound for low voltages. A condition, as shown, will cause excessive heating of the faulty coil, and will burn it out in a short time.









Current Directions in Short-Circuited Armatures

The cause of the heating in the coil will be understood, when it is remembered that the faulty coil makes a closed circuit on itself. Consider the winding moving by the pole pieces in a direction indicated by the arrow *t*, in which case conductors under the respective poles will have electromotive force induced in them, as shown by the arrow-heads. This will make brushes B_1 and B_3 positive and B_2 and B_4 negative terminals, but no current can flow through the winding, until the external circuit is closed. If coil 7 is closed as indicated by the dotted line *s*, a current will flow around in the coil, and as the resistance of the coil is low, the current will soon reach a value sufficient to increase the temperature to a point where it will destroy the insulation, and may also destroy other coils located in that region, unless the faulty coil is soon detected and repaired. Usually the faulty coil can be easily located by running the machine for a short period, say half a minute, and then feeling with the hand; the defective coil will be much hotter than the others. Care should be taken in doing this, for the excessive heat generated in the defective coil will soon spread to the adjacent coils. If there is any doubt as to the defective coil, the armature should be allowed to cool, and the test repeated. Another indication of the defective coil, is a softening of the insulating compound in the insulation, and sometimes smoke emanating from the coil, if the armature has been allowed to run too long while making the test. If the coil is burned out, it is easily detected by the charred condition of the insulation.

After the defective coil is located, to repair it will necessitate removing the armature from the machine, taking out the coil and either making a new one or re-insulating the defective one, and placing it back in the winding. This requires considerable time and it may be inconvenient to have the machine out of service for so long a period. Fig. 2 shows a rough and quick way in which this defect can usually be eliminated:

First, cut the coil in two; this can, in most cases, be best done on the back end of the armature, as at *x*, in coil 7. This opens the short-circuit but leaves the coil open-circuited, which will have the same effect as that described in Fig. 1, Part 1. If the machine is started and run for a few minutes, a burnt spot will occur on the commutator

between the terminals of the defective coil, in this case between segments *d* and *e*. By connecting segments *d* and *e* together, as shown by the dotted line *s*, the open circuit is closed, and so far as the satisfactory operation of the machine is concerned, it will be the same as before the trouble occurred, and machines have been known to operate satisfactorily for years with just such a repair.

If the armature is series-wound, a better way of repairing the open circuit would be as described in Fig. 6, Part 1. In some cases the conductors in each half of the coil may be twisted or soldered together; this will close the open circuit and eliminate its repair at the commutator.

Second, a short between two of the commutator bars, as indicated at *x*, Fig. 1, will short-circuit coil 15, the arrow-heads indicating the closed circuit. This will cause heating of coil 15, although not to such an extent as the short-circuit in the coil itself. This short-circuit between commutator segments is usually caused by the mica between them carbonizing. The carbonized mica represents a large percentage of the total resistance in the coil circuit, which keeps the current down to a lower value than it would be if the coils were short-circuited copper to copper. This point of comparatively high resistance usually increases the temperature of the commutator segments between which the short-circuit occurs to such an extent that they force up higher than the rest, and, if not detected, the segments may rise up far enough to destroy the brushes. In one case that the writer can recall, the brushes knocked two segments out of the commutator when they were forced up higher than the rest, due to a short-circuit between the bars.

Trouble of this nature in most cases can easily be located and repaired by sawing down the mica between the commutator bars with a hacksaw blade, until the defective mica is all removed, then drive a piece of sheet mica into the defect and file the high bars down to a level with the rest of the commutator. If the defect cannot be repaired in this way, one of the coil leads may be removed from either one of the segments between which the fault is located as at *r*, Fig. 2, and the two segments may then be connected permanently together. This necessitates the loss of a good coil in the armature. To avoid the loss of the coil, both coil leads could be removed from either segment, the two leads connected together as shown at *u*, and the two segments between which the defect is located soldered together. This method is defective in that it doubles the potential between the segments *i* and *j*. If the insulation of the commutator is poor, this may cause another breakdown between these two segments, and on this account it may be better to leave the coil out of circuit entirely, as shown at *r*.

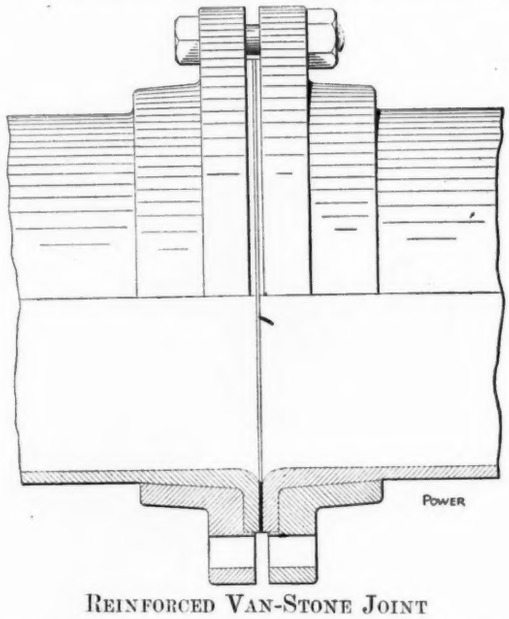
Third, a short-circuit may occur between the leads of two coils located in different parts of the armature, as at *s*, Fig. 3, or between the two coils in the same slot, as shown at *t*; in either case this short-circuits a group of coils, which will have the effect of a heavy overload on the machine. If in a generator, it will fail to generate, and if the fields are excited from an outside source, the prime mover will have difficulty in bringing the machine up to speed. If in a motor the machine will start with a jerk and will draw excessive current from the line, which will soon cause excessive heating in the starting device and will blow the fuse before many points of the starting resistance are cut out.

A test may be made for such a condition by exciting the fields from an outside source, and then turning the armature by hand. If there is a short-circuit between coils, as shown in Fig. 3, the armature will turn harder at some points of the revolution than others. The cause of this is that when the group of short-circuited coils are under the pole pieces, current is generated in them of a direction which opposes the turning effect applied to the armature. When the group is between the pole pieces, no current is set up in the coils and the armature requires less effort to turn it.

Cross-connected coils will cause serious sparking at the brushes. This is the fault of the individual who made the connections between the coils and commutator, and if the armature is carefully tested in the shop it should never get out in this condition. Fig. 4 illustrates two ways in which this mistake may occur. At segments *c* and *d*, the two leads to each commutator segment are shown interchanged, while terminals of coil 14 are shown reversed at *k* and *l*. The first will cause sparking at the brushes only, while the second also causes local currents to flow in the armature, which will cause heating.

Improved Reinforced Van Stone Joint

A type of Van Stone joint, known for a number of years as the improved reinforced lap joint, is made by



REINFORCED VAN-STONE JOINT

spot welding a collar to the end of the pipe, which is then flanged.

After flanging, the joint is faced on the front, edge and back and turned on a regular taper to the end of the collar to fit a correspondingly tapered bored flange. The matching is done so that a neat fit is obtained between the pipe joint and the flange.

This joint gives about one and a half times the thickness of full-weight pipe on the face and double the thickness of the pipe through the curve. The joint, see illustration, is manufactured by W. K. Mitchell & Co., Inc., Twenty-ninth and Ellsworth Streets, Philadelphia, Penn.

Editorials

Outward Appearances

Clean paint and brightly polished metals do not make an engine run any better. No more does a white tongue nor a yellow complexion cause sickness, but where these are seen they are evidences of something wrong somewhere that does result in illness. We are admonished not to judge by outward appearances, but there are exceptions to this rule when it is decidedly in order to ignore such advice.

While the neat appearance of a plant proves nothing of the efficiency and economy of its equipment, it is a fairly safe index of the character of the engineer in charge. While "clothes do not make the man," they are an important means of arriving at some idea of him where circumstances may not afford any better knowledge. The right kind of man usually pays just enough attention to his dress and no more. If he is overdressed, it is as much a mark of a lack of desirable qualities as if he is slovenly dressed.

So, too, in the engine room. The engineer who pays too much attention to the looks of his machinery has not time enough or does not think deeply enough to keep the wastes and leaks out of the operating expenses. But, whoever knew an engineer who let dirt and rust accumulate in out-of-the-way places to bother about indicator diagrams or flue-gas analyses?

Carelessness of the outward appearances almost invariably extends to everything else with which the individual has to do.

Safety Factors

There appears on another page of this issue an abstract of the memorandum of the chief engineer of the Manchester Steam Users' Association for 1913, in which is described a practical method of obtaining the fatigue limit or true elastic limit of a material.

As has been before pointed out in these columns, the factor of safety is often erroneously referred to as a "factor of ignorance," when, for the most part, it is not used to cover any really unknown conditions with regard to the strength of the material to which it is applied, but to cover the uncertainty as regards the fatigue limit or true elastic limit, which is the logical measure of the ability of a material to stand repeated applications of a given load. Heretofore there has been no practical way by which the true elastic limit could be really obtained, and since the ultimate strength was a property that gave fairly uniform results with the usual test methods employed, it has been used as a measure by which the safe load was estimated, the correct safety factor to be applied to this measure being determined by experience.

With a practical method for determining the true elastic limit available, the methods of design and selection of material may be radically changed, and the factor of safety required in many cases could be reduced to a very small figure, for often the estimation of the true values of the applied stresses can be made with considerable precision.

What is more important than to be able safely to reduce the safety factor required, as may result from the methods of testing discovered by Mr. Strohmeyer, is the determination of a coefficient for each material by the formula which he derives. With this coefficient known, it can be predicted whether a material will stand few or many repeated stresses beyond its elastic limit, and since in some structures it is practically impossible to provide against such excess stress, the determination of this coefficient for the material to be selected for such parts is a matter of utmost importance. This is clearly demonstrated in the example selected to illustrate the influence of the coefficient, for with two metals not greatly at variance as to the true elastic limit, one was shown to be immensely superior when subjected to stresses beyond this point. Mr. Strohmeyer has attacked the problem of obtaining the true elastic limit in an original manner, and his test may become as general and as useful as that by which the ultimate tensile strength is determined.

Engineering Salesmanship

"Having two boilers, each carrying sixty pounds pressure, it will not be necessary to make any changes in the boiler plant as this engine will operate economically on one hundred and twenty pounds pressure." This contention (about as sound as the claim that two horses can run faster than one) was made to an engineer by a young salesman of steam engines.

The management was considering the installation of an engine-generator unit for light and power, but as the maximum pressure allowed on the boilers was only sixty pounds, the steam being used for heating and sterilizing, the idea was abandoned because a lack of funds forbade the purchase of new boilers. This difficulty did not appear insurmountable to the young man, as shown by the information he volunteered.

All of us on numerous occasions have been entertained by handsome, well groomed salesmen, massaged, manicured and full of "selling talk," "talking points" and superlatives to the extent of being tiresome, but their knowledge of the practical working of the apparatus they were trying to sell was not what it should be. Salesmen who visit a Turkish bath before calling on a prospect may be necessary in some lines, say face-powder and perfumes, but not to sell steam specialties. Who would not prefer to talk with a salesman who looked as well as talked as though he could install and then operate the thing he sold?

Inspired by the question, "Why do not more engineers become salesmen?" a certain competent engineer answered a number of advertisements for salesmen of steam specialties. In his letters he attempted no flourishes, confining himself to plain facts and frankly stating that he had had no experience in salesmanship. Nearly all his letters were ignored, or at least were not answered. One reply

was a polite rejection on account of his inexperience, and one was favorable.

To make the average engineer an acceptable salesman it would seem necessary that he somehow acquire selling experience (how to get it without being given the first opportunity to try is a bit obscure); then so improve his personal appearance as to make a good "front," and lastly, study how to properly present his goods. Many an article has been sold, not because of any particular merit nor because it was really wanted, but because the buyer was "talked into" buying.

The Kilowatt and the Horsepower

The Bureau of Standards has got out a second edition of its pamphlet dealing with the relation of the kilowatt to the horsepower. It has adopted 746 watts as the standard horsepower. When this was first proposed, we nodded approval, but this apparently simple simplification involves the upsetting or the establishment of another standard, the desirability of accommodating which to this specific and not overwhelmingly important case may well be questioned.

The watt is the metric or C. G. S. (centimeter-gram-second) unit of power; ten million ergs per second. The erg is the C. G. S. unit of energy; one dyne-centimeter—i.e., a force of one dyne exerted through the distance of one centimeter. The dyne is the C. G. S. unit of force, and is that force which, exerted for one second upon a mass of one gram, will give it a velocity of one centimeter per second. The gram is the metric unit of mass equivalent to that of a standard weight kept at the International Bureau of Standards near Paris and intended to be equal to that of a cubic centimeter of pure water weighed in a vacuum at its maximum density. The centimeter is the one-hundredth part of the length of the standard meter, that of a bar kept at the same place and intended to be the ten-millionth part of the distance from the equator to the north pole measured on an arc of a meridian.

Our unit of power is the horsepower, 33,000 foot-pounds per minute. The foot-pound is our unit of energy. The only legal definition of the foot in the United States is an act of Congress of July 28, 1866, fixing the relation of the inch to the meter as 39.37 inches. We have no legalized inch, foot or yard except as they are derived from the standard meter in accordance with the ratio so established. In England the meter is legalized as 39.370113 inches, so that the English inch, foot and yard are slightly different from ours. We have no legalized unit of pressure or force comparable with the metric dyne except the little-used poundal, the force which acting for one second on a mass of one pound will give it a velocity of one foot per second. We usually measure pressures in pounds, but what is a pound of force? A pound weight might be thought to exert a pound of force upon the weight pan of the balance in which it is used or upon a cord with which it is suspended; but this force will be different at different places because the earth attracts the weight with different degrees of force at different latitudes and elevations. It has been usual therefore, although so far as we know there is no legal authority for it, to consider the pound, when used as a unit of force, as that force with which the earth attracts a standard pound weight at latitude 45 and at sea level. All of the modern steam tables are computed upon this basis.

Using this established value of the pound as a unit of force and the legalized value of the foot, a horsepower of 33,000 foot-pounds per minute equals 745.65 watts, and it is as impossible to change this relation by any decree as it is to make the ratio of the circumference to the diameter of a circle 3.14 by passing a law to that effect.

The only way to make the ratio 746, assuming the value of the watt to be fixed, would be to change the value of one of the factors of the horsepower. To change 33,000 to the awkward, inexact value 33,015.49 would be to incur more trouble than we would be avoiding. It might be done by changing the legal value of the meter in inches to 39.3515, which would make the legal foot less than six one-thousandths of an inch longer than the present; but this might be important when the larger derivatives of the foot, as acres and miles, are concerned. The only other way is to change the accepted value of the pound as a unit of force, and this is what the Bureau does, using as that value the force with which the earth attracts a standard pound weight at latitude 50 instead of at latitude 45.

Steam of a certain pressure acts in an engine, and from this pressure its horsepower is determined. To be consistent with the new practice of the Bureau, we must measure this pressure in the new units. But the steam tables give us the physical properties of steam measured by the old 45-degree unit. Must we make the steam tables over?

This discussion is all academic. Everybody uses 746 for ordinary calculations, just as they use 778 foot-pounds for the mechanical equivalent of heat, and the case is difficult to imagine where it would make any practical difference whether a horsepower were legally equivalent to 746 or 745.65 watts.

But there is a phase of this discussion which is of practical interest. It has been often said, and rightly so, that the horsepower is an irrational, archaic unit, and ought to be abandoned in favor of the kilowatt. The Bureau in the circular under review repeats the argument and reiterates the recommendation. But how shall we, with the dimensions of our engines in feet and inches and with our pressure in pounds per square inch, conveniently compute their power in kilowatts? Surely not by computing the horsepower and multiplying by 0.746. That is no way to get rid of the horsepower. A kilowatt is 44,256.7 foot-pounds per minute. The formulas stand

$$hp. = \frac{PLAN}{33{,}000} \qquad kw. = \frac{PLAN}{44{,}256.7}$$

If there is going to be any change in our units either of pressure, length or area, let it be such as to make the divisor for the kilowatt as simple as that for the horsepower. Then the newer and more rational unit will rapidly replace the old. So far as its use as a unit of boiler capacity is concerned, the horsepower has no excuse for continued existence and should have been abandoned years ago. The present practice of running boilers over rating and the improved efficiency of engines and turbines increase the discrepancy between the capacity of a boiler rated in horsepower and the horsepower got out of it in service, and are additional reasons for the abandonment of an unscientific and unsuitable unit.

Correspondence

Records to Detect Coating of Turbine Blades

Turbine operators keep such data as load, steam pressure, vacuum, pressure of the various stages, etc. In view of an operating condition in some plants, where scale-forming matter contained in the feed water coats the blades of the turbine to such an extent as to seriously interfere with the efficiency as well as to impose undue end thrust on the unit, a continuous record should be kept of the position of the inlet valves at the various loads.

This can be easily noted with the larger types of impulse turbines as they have many inlet valves, the number in service varying as load conditions change. The operator could note the number open or partially open and a comparison checked over a year's run of the valves required for any load will be an unfailing indication as to the condition of the turbine blades.

JOHN F. HURST.

Louisville, Ky.

Does Oil Attack the Engine Cylinders?

The inquiry of B. F. Mayer on the above subject, page 537, Oct. 13 issue, is interesting. The writer has had analyses made of the cylinder oils in use in various plants, and while they include most of the usual brands of oils, in no one analysis has more than a trace of acid been shown. It is hard to believe that any reputable oil dealer would attempt to market a standard or special grade that contains acid.

Mr. Mayer says that the engines are triple expansion, each having two large low-pressure cylinders, and that the vacuum is 27 in., but he does not state whether the trouble is with all the cylinders, although it can be inferred that it is with the low-pressure ones only.

Every engineer accustomed to starting up new machinery realizes the importance of flooding the bearing surfaces with oil until they have become smooth and polished. In the case of a large horizontal Corliss engine, not only must the valves and the packing rings in the cylinder be lubricated, but also the bottom of the cylinder, which in the absence of a tail rod has to carry the entire weight of the piston and the piston rod. A further reason for the use of a liberal amount of oil in the early stages of operation is that, no matter how carefully the steam pipes and passages are blown out before starting, some dirt will remain. When this dirt becomes loosened by the expansion and contraction of the pipe and by the pulsating movement of the steam, it is carried to the cylinders. Therefore, unless the oil is used very freely, trouble will often result.

While there are many triple-expansion engines the low-pressure cylinders of which take steam at about atmospheric pressure and exhaust into the high vacuum that can be maintained (27 to 28 in.), and operate successfully and present no difficulties in lubrication, yet occasionally trouble such as Mr. Mayer describes is met.

Assuming that the engines have been built by a reputable company and represent its standard practice in materials and workmanship, the question of hardness or softness of the iron can be eliminated, at least for the time being. It may also be assumed that the engines are in alignment, with no distortion due to expansion.

With the use of a suitable oil and the correct introduction of it into the cylinders, there should be no difficulty in lubricating them. The amount necessary would have to be determined by experiment and trial extending over considerable time. Regardless of how much oil is used, it is difficult to understand how it could attack the cast iron.

If the oil contains acid it should not be used. If one is sure the oil is all right and the cutting occurs, it is then important to determine whether it takes place continually or at intervals of from one to several weeks or months. If the latter is the case, the trouble is usually because of impurities in the steam. Such impurities may be due to the nature of the feed water alone or to a boiler compound or combination of both. Analyses of the feed water and of the water from the traps taken under normal conditions may not show anything wrong, but analyses are seldom made during an emergency or at abnormal conditions of operation.

Triple-expansion engines of this type are difficult to lubricate, owing to the low pressures and temperatures prevailing—initial pressure about 15 lb. absolute and temperature 212 deg.; exhaust pressure about 1 lb. absolute and temperature about 100 deg. F. in the low-pressure cylinder. Any impairment of the quality of the oil or interruption of feed for a long interval usually results in cutting the bearing surfaces.

W. HAMILTON.

Troy, N. Y.

It is rather difficult to prescribe "absent treatment" for Mr. Mayer's case, but having had trouble with cutting cylinders, the following may be worth as much in his case as it was in mine:

If the piston rings and bull ring are sharp and square on the edges, they may be scraping the oil off the cylinder surfaces and cutting them. The remedy is to slightly chamfer the edges of all the rings. This allows the oil to work under them and lubricate properly and adequately.

It would be interesting to know just what Mr. Mayer's trouble is, if he finds out.

WILLIAM N. WING.

Brooklyn, N. Y.

This rapid cutting of the cylinder walls, described by Mr. Mayer as being of "soft, coarse gray iron," is more likely to be due to excessively tight packing rings with sharp edges than to acid-bearing oil.

A glance at the cylinder bore would tell if the trouble is due to acid; if so, the cylinder would show a peculiarly pitted surface. When viewed through even a low-powered microscope, the attacked surface has the appearance of being etched. The pitting effect is never uniform and tends to spread like a fern. Furthermore, the action is most apparent where the temperature is highest, since an acid is more active when hot.

Mention is made of a high vacuum. This would tend to decrease the chemical effect of acid since the higher the vacuum the lower the corresponding temperature. That the high and intermediate cylinders are made of closer grained iron would not make them immune to acid, for acid attacks a hard surface quite readily; the "etching" effect is of a finer pattern than in the case of a coarse-grained iron.

It is quite true, as Mr. Mayer has been advised, that acid will penetrate beyond the surface. Cylinders are sometimes pickled in acid at the foundry. When being bored, even weeks after pickling, the acid will dampen the metal at any spongy place and apparently ooze to the surface under the cutting action of the boring tool.

I have successfully used a mixture of one part cylinder oil to one part fine flake graphite to prevent cutting valves and piston rings, and I would recommend this to Mr. Mayer. The oil should be heated before adding the flake graphite.

E. HURST.

Montour Falls, N. Y.

Cooling Effect of Evaporation

An article under the above heading on p. 512, Oct. 6, explained clearly why liquids evaporate more rapidly when a current of air is passed over them. It might have gone a little further and told how the evaporation of the ether freezes the water—i.e., when a pound of ether is evaporated at atmospheric pressure, 162.8 B.t.u. are required to effect this change. This is called the latent heat of vaporization and is that which is required to change the condition of the molecules; it does not appear as sensible heat. If the vapor is again condensed or compressed, however, each pound of ether would again give up its 162.8 B.t.u. of latent heat.

Where evaporation is produced, as described, by a current of air, the ether receives very little heat from the air stream, but heat must be supplied before the liquid can evaporate and it is simply drawn from the remaining ether, which in turn draws heat from the water. This lowers the temperature of the water to the freezing point.

Here again latent heat is encountered, for it is not sufficient simply to lower the temperature of the water to the freezing point, as after reaching that point there must be extracted for each pound of water 144 B.t.u. before the water becomes ice.

Of course, the amount of water used in the experiment is comparatively small, so that the total heat to be withdrawn is a very small quantity, but all of the ether that is not evaporated is lowered to a temperature at least slightly below the freezing point of water so that the experiment succeeds best when only a small amount of ether is taken.

P. L. WEIMER.

Gary, Ind.

Queer Compressor Diagrams

In his letter, in the Oct. 13 issue, p. 541, Mr. Crawford says in regard to the diagram, Fig. 2: "It indicates that the compressor is in good condition."

I differ with him, for something seems wrong with the discharge valve. By analyzing Fig. 1, which is a reproduction of the diagram, this is made plain. Starting at *A*, the piston compresses the gas to *B*, where the discharge valve opens and lets the gas escape to the condenser. The pressure then drops to *C*, where the discharge valve closes and it is again raised to *D*, when the discharge valve again opens. The pressure then falls to *E*, which should be the condenser pressure. It seems impossible for the gas to leave the cylinder at a lower pressure than the condenser pressure, and such being the case, line *F* is the condenser pressure and the machine is pumping against an excess pressure from the line *F* to *H*. It also seems that the spring on the suction valve is too tight as shown by the wavy line at *G*. Of course, it is impossible to tell much about ammonia diagrams unless the theoretical expansion curves are drawn on them.

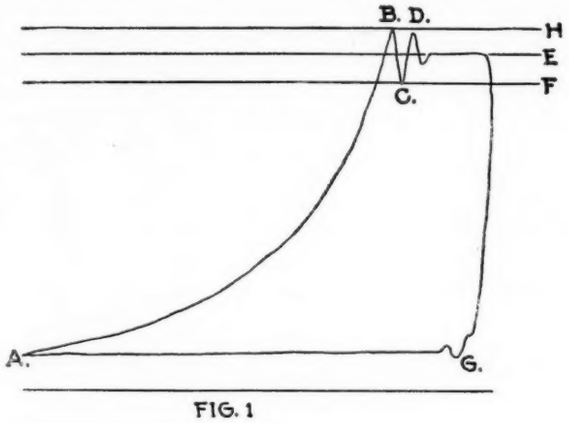


FIG. 1

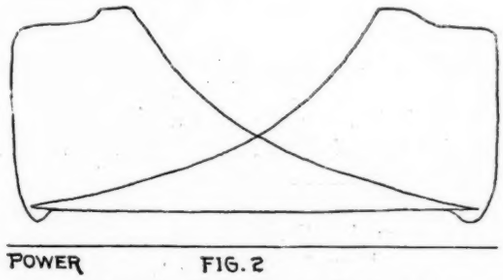


FIG. 2

AMMONIA COMPRESSOR DIAGRAMS

I have drawn the adiabatic and isothermal curves on two diagrams that looked excellent, but the curves showed the discharge valves to be leaking badly. An ammonia compressor diagram does not seem to be as well understood by the average engineer as are those from steam engines. As an example, Fig. 2 is a reproduction of a diagram shown in the advertisement of a manufacturer of a double-acting compressor. The figure shows that both the discharge and suction valves stick. Two or three hours' work on these valves would have eliminated this trouble, and the humps on the diagrams would have been absent. A small amount of reëxpansion is shown, considering that long pipes were used. This is a wrong way to connect up the indicator as the long pipes make quite a difference in the reëxpansion shown on the

diagram over that which a short pipe connection and a single diagram show. These people evidently did not understand this or they would not have used this diagram for advertising purposes.

PERRY LOSH.

Muncie, Ind.

Test of Lentz Engine

In the issue of May 28, there was published a discussion by Mr. Rosenzweig of the tests which I made on a simple noncondensing Lentz engine. For personal reasons, I hesitated to reply at the time, but it now happens that somewhat similar and carefully conducted tests, made in a Western state by a well qualified engineer, are being prepared for publication. Since in these tests the temperature of the superheated steam supplied to the engine was measured, as in my test, with a carefully calibrated mercury thermometer, it seems necessary to state the case a little more fully.

Mr. Rosenzweig used as a basis for his computations the temperature of the steam in the exhaust pipe, and calculated that, if a theoretically adiabatic expansion is assumed, the actual superheat would be nearly 100 degrees higher than that observed and reported. There are several reasons why this assumption is improbable. In the first place, the temperatures in the exhaust pipe were observed merely as an afterthought. The thermometer used was put in the exhaust pipe by one of the testers for his own information and no precautions were taken to insure the accuracy of these observations. Furthermore, the thermometer was not calibrated and the thermometer well used at this point was very shallow. These facts should make any discussion from this basis of doubtful value.

It is improbable that the carefully calibrated thermometer, corrected for stem exposure, which was used for measuring the initial temperature of the steam could have been in error anything like 100 degrees, and it is admitted by Mr. Rosenzweig that there is no doubt whatever as to the accuracy of observing and recording this temperature. He also assumes that the expansion is adiabatic. In an engine having no steam jacketing on the cylinder, of moderate speed, and using steam of very high temperature, it is obvious that the expansion does not follow closely the adiabatic.

As regards the argument itself, that a mercury thermometer is unsuitable for measuring the temperature of superheated steam, the error is likely to be of much more significance in obtaining the temperature in the exhaust pipe than that of the highly superheated steam. It is well known that the temperature of steam of from 0 to 20 degrees superheat is difficult to measure, as it is almost impossible to eliminate all the moisture present in superheated steam of this low degree.* At these low degrees of superheat, the steam is usually more or less stratified, some wet steam being present. The latter lies nearer to the bottom of the pipe than that which is superheated, and not infrequently water is found either entrained or in a liquid mass in the bottom of the pipe, where it remains unevaporated by the flow of superheated steam over it. Undoubtedly these were the conditions existing in the exhaust pipe of the Lentz engine tested, hence they should have little significance, even if the observations of the steam temperature in the exhaust pipe had been made with an accurate or properly calibrated thermometer.

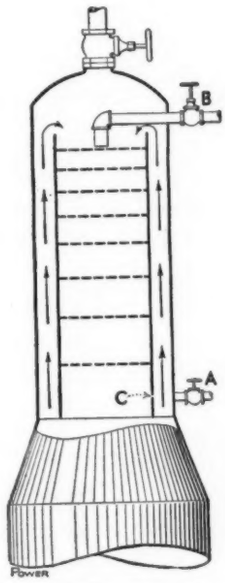
J. A. MOYER.

State College, Penn.

*See "Steam Turbines," by J. A. Moyer, second edition, pp. 261 and 262.

Strong Aqua Short-Circuit in Analyzer

Recently I had occasion to renew the steam coils in a high-pressure-steam ammonia generator in an absorption plant. After the unit had been dismantled, a friend suggested that I change the point of entering the strong aqua from the pump to the generator, to allow the pump to discharge directly on the top of the analyzer pans instead of at the base of them. This would make it necessary for the aqua to come to the top before it could start on its downward course over the analyzer pans. The reason for suggesting the change was to prevent short-circuiting the strong aqua through a part of the analyzer pans. The sketch shows what changes were made.



ANALYZER FOR AMMONIA GENERATOR

Valve *A* is where the strong aqua was formerly discharged, and the arrows indicate the path it took after entering the generator at the base of the analyzer. This valve was blanked off and a hole drilled and tapped into the shell for the line *B*, the shell at this point being 2⅛ in. thick. The hole was tapped out $1\frac{1}{16}$ in. from both inside and outside the shell, to enable a nipple to be screwed into the shell from both sides. A short nipple with valve *B* was screwed into the shell from the outside, to which the aqua pump discharge was connected, and a nipple long enough to bring an ell to the center of the shell was screwed into a hole on the inside. The ell turned down with a nipple screwed into it, terminating within 4 in. of the bottom of the top analyzer pan as shown. The ammonia-gas outlet is, of course, at the top of the generator and is controlled by a valve.

Before making this change, it was almost impossible to keep the joints between the pans tight, and they showed that the aqua was short-circuiting through them and passing down onto the steam coils.

A half-inch hole was drilled in the analyzer base at *C*, to prevent aqua getting over the pans and trapping in the bottom of the analyzer. The manufacturers of these generators have adopted this method of entering the strong aqua to the analyzer in their later generators, but the generator referred to in this article was one which was built several years ago.

The principal requirement in making such a change is to get a good thread when tapping out the hole after it has been drilled.

C. T. BAKER.

Jacksonville, Fla.

Engineers' Study Course

Problems in Power-Plant Design--V

Layout of the Power House

In laying out the power house, no attempt will be made to go into details of construction. The idea is to study the arrangement of the different parts of the equipment with special reference to convenience and economy of operation, and to furnish diagrams and dimensions from which the architect may prepare designs for the building. The sketches of boiler settings, etc., are such as would be given to the head draftsman from which to work out the detail drawings.

Boiler Settings

The first step in laying out the power house is to determine the space required by the boilers, and simple diagrams of the settings are prepared for this purpose. It seems a good arrangement, in the present case, to set the boilers in batteries of three each, and Figs. 1 and 2 have been worked out on this basis.

Heavy "Hartford" settings have been used with the outer or supporting walls 30 in. thick, consisting of an inner wall 16 in. thick, a 2-in. air space and a 12-in. outer wall. The division walls between the furnaces are 32 in. thick, the bridge-wall 28 in., and the rear walls 26 in.,

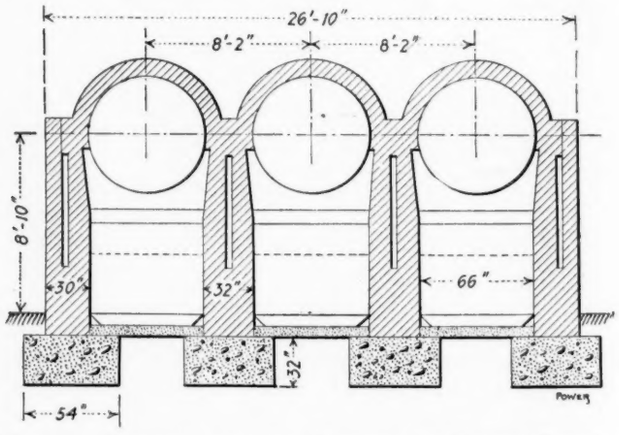


Fig. 1. Section through Battery of Three Boilers

with a 2-in. air space. Table 1 gives overall dimensions for boilers of different diameters with heavy settings for power work.

TABLE 1—DIMENSIONS OF BOILER SETTINGS

No. of Boilers in Battery	Diameter of Boiler, In. 54	60	66	72
Width of setting, 1 boiler..	9′ 0″	9′ 6″	10′ 0″	10′ 6″
Width of setting, 2 boiler..	15′ 8″	16′ 8″	17′ 8″	18′ 8″
Width of setting, 3 boiler..	22′ 4″	23′ 10″	25′ 4″	26′ 10″
Width of setting, 4 boiler..	29′ 0″	31′ 0″	33′ 0″	35′ 0″

The total length of the setting is equal to the length of the tubes plus 4 ft. 2 in. for the diameters in Table 1. If the "gallows frame" support is employed, lighter walls may be used. With columns between each boiler, the girders for 6x16-ft. boilers should be made up of two 9-in. channels, with suspension rods 1½ in. in diameter. If wrought-iron pipe columns are used, they should be 9 in. in diameter and the lower ends should be embedded from one-fourth to one-third their length in heavy foundations of concrete.

Furnace

This is made of good height for burning bituminous coal. If mechanical stokers are employed the furnace

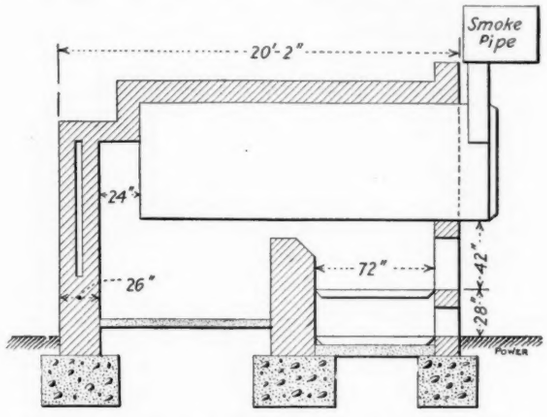


Fig. 2. Longitudinal Section of Setting

details should be furnished by the makers and all dimensions obtained from them. The grate area is found by the formula

$$S = \frac{hp. \times 34.5}{E \times C}$$

in which

S = Grate area in square feet;
E = Pounds of water evaporated per pound of coal;
C = Pounds of coal burned per square foot of grate per hour.

With natural draft, C should equal at least 15 lb.; and with clean tubes and skillful firing an evaporation of 9 lb. of steam per pound of coal should be obtained. Table 2 is computed from the above formula for different values of E and C, covering ordinary conditions of power-plant work, and gives the square feet of grate surface per horsepower for different combinations.

TABLE 2—GRATE SURFACE PER HORSEPOWER

Values of C	Values of E 12 Lb.	15 Lb.	20 Lb.
10	0.28	0.23	0.17
9	0.32	0.25	0.19
8	0.36	0.29	0.22

Assuming values of 9 and 15 for C and E, respectively, for the present case

$$120 \times 0.25 = 30 \; sq.ft.$$

of grate area should be furnished for each boiler. The dimensions given on the drawings are

$$5\tfrac{1}{2} \times 6 = 33 \; sq.ft.$$

The main smoke pipe may be proportioned on a basis of 1 sq.ft. area to 7 sq.ft. of grate, which for five boilers running at one time will call for

$$\frac{5 \times 30}{7} = 21.4 \; sq.ft.$$

This may be made 4 ft. wide by 6 ft. in height, which gives a flue on the side of safety. The extreme end of the flue may be made about 20 in. in height and increase uniformly to the boiler nearest the stack, the width being kept the same throughout. It should be made of No. 10

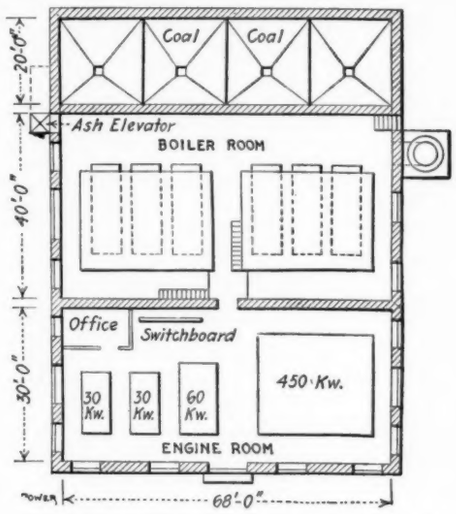


FIG. 3. GENERAL ARRANGEMENT OF BOILER AND ENGINE ROOMS

iron, on an angle-iron frame, and hung from the roof trusses. The uptakes from each boiler should be 12x60 in.

CHIMNEY

The required height of chimney will depend largely upon the kind of fuel to be burned and will vary from 120 ft. for slow-burning bituminous up to 150 ft. for buckwheat. For plants of 600 to 800 hp. and over, the chimney should not in general be less than 150 ft. in height, whatever the grade of fuel to be used. Assuming this height in the present case, we find from Kent's formula that a flue 5 ft. in diameter will be required.

BOILER- AND ENGINE-ROOM DIMENSIONS

The general arrangement of the boiler and engine rooms is shown in Fig. 3. Ample space has been allowed around the boiler settings, giving a 4-ft. walk at each side and a central space between the two batteries of 6 ft. 4 in. A passageway 6 ft. in width has been provided at the rear, both central and rear passages being widened somewhat to allow for the iron stairways leading down from the engine room. A firing space of 14 ft. is allowed in front of the boilers which provides for drawing the tubes beneath the front of the coal bunker.

The overall spaces required by the different generating sets have been drawn in from catalog dimensions and a room 30x68 ft. seems to give ample space for all requirements. The different floor grades of the power house are shown in Fig. 4, which represents a longitudinal section. This arrangement, with the main engine-room floor above that of the boiler room, makes it possible to carry all exhaust piping beneath the floor and provides a space for condenser and pumps at the boiler-room level beneath that corner of the engine room occupied by the private office and switchboard. It is always desirable, if possible, to place the condenser at a lower level than the engine on account of drainage and simplicity of pipe connections.

This plan also makes it possible to enter the pipe tunnel easily with the heating main and to connect the main return with the receiving tank without providing a pit or trenches. The engine room is entered by two or three steps from outside grade. Besides the various generating sets, it contains the switchboard and a gage-board carrying a series of pressure gages connecting with various parts of the system, also an air compressor and storage tank for supplying air pressure for cleaning purposes around the engines and generators.

The boiler room is reached by two flights of iron stairs from a platform at the engine-room level. A separate entrance is also provided from outside near the chimney, as shown. The large window on the opposite side is removable, leaving an opening large enough for removing a boiler if desired. A traveling overhead crane should

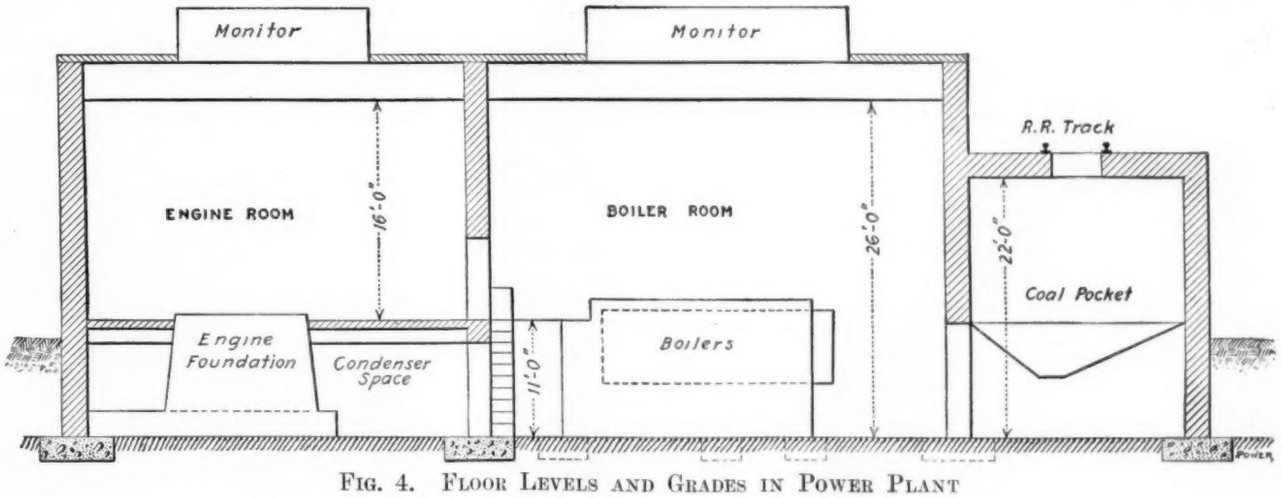


FIG. 4. FLOOR LEVELS AND GRADES IN POWER PLANT

be provided of sufficient capacity for handling the boilers in case of renewal. The ash elevator at the left is of the conveyor type and arranged to discharge directly into a car standing upon the raised track over the coal bunker.

COAL STORAGE AND HANDLING

For the storage of the coal the space required will depend upon the amount it is desired to keep on hand or have delivered at one time. Factors of this kind will vary with local conditions and must be decided upon in

each particular case. In the present problem let us provide storage capacity for at least six weeks' supply for the maximum 600 boiler-horsepower.

Assuming four pounds of coal per horsepower per hour, eight hours run per day for six days per week will call for

$$\frac{4 \times 600 \times 8 \times 6 \times 6}{2000} = 345 \textit{ tons}$$

Assuming 35 cu.ft. of space per ton,

$$345 \times 35 = 12{,}075 \textit{ cu.ft.}$$

of storage space will be needed. Making the bunker of the dimensions shown in Figs. 3 and 4 will give the following capacity, allowing for the slope of the coal when dumped from the car:

$$20 \times 68 \times 9 = 12{,}240 \textit{ cu.ft.}$$

In the arrangement shown, the coal cars are run up an incline to the top of the bunker and their contents dumped through openings as indicated. The bottom of the bunker is provided with four chutes with sloping sides from which the coal is delivered into tram cars and brought to the boiler fronts for firing. If automatic stokers are used a special conveyor may be provided for delivering the coal directly into the hoppers, or an elevator and raised track may be so arranged that the contents of the tram cars may be dumped into the hoppers without shoveling. These are matters of detail to be worked out according to the amount of money available for equipment.

Foundation

The foundations for boilers, engines and chimney are important matters and should receive careful attention. In the case of heavy boiler settings for power work the foundations may be made from 20 to 24 in. wider than the brickwalls which they are to support if a solid earth footing is available. If this is not the case, the weight must be computed and the bearing area of the foundation made such that the load will not exceed the following limits per square foot: Soft clay, 1 ton; stiff clay, well packed sand and loam, 2 tons; coarse gravel, 8 tons.

In some cases, if the soil is of low-bearing power, a solid bed of concrete may be laid down for the boilers to rest upon. The depth should be from 2 to 4 ft., according to the size of boiler. What has already been said applies also to engine and chimney foundations.

With mud, silt or quicksand in a thin layer it may be possible to excavate to the gravel, clay or rock substratum and carry the foundations down to rest upon this. In the case of thick layers, piles should be driven on 2- to 2½-ft. centers and the tops cut off below the level of the surface water. A layer of concrete 2 or 3 ft. in thickness should be laid over the piles with their tops extending into it, and on top of this the regular foundation.

In computing the weight of a chimney the following figures may be taken: Granite masonry weighs from 150 to 170 lb. per cu.ft., and brickwork from 120 to 130 lb.

When there is any doubt as to the nature and carrying capacity of the soil an expert should be called in to fix a safe value before designing the foundation.

Line Loss—Conditions may readily occur in connection with wiring where the drop may not be sufficient to cause any difficulty in the operation of lamps or motors but if the loss over these wires is figured, it will be found advisable to use larger wire, as the interest on the increased cost of the wire will be less than the loss of power by the use of the smaller wire.

OVER THE SPILLWAY

JUST JESTS, JABS, JOSHES AND JUMBLES

Science has proved that coal does not deteriorate in storage. But we have coal to burn. Can't some thoughtful scientist do something to ameliorate the condition of the egg? Its deterioration in storage is something fierce, not to say rotten.

"The governor went to pieces suddenly." This happened in several states recently. Well, when the "plant" outlives its usefulness, scrap it and get new apparatus—which has also been done in several recent instances. There are many "engineering" points in politics that stick out just like they do in our own field.

The newspapers have given wide vent to the foot-and-mouth disease among our cattle. This head-to-foot trouble give rise to the sweetly solemn thought that the disease probably had its origin in the thickhead who every time he opened his mouth he put his foot in it—and the complaint is more prevalent than is popularly supposed.

Know how to detect a liar? Easy! Put your finger on his pulse. If the blood pressure is unsteady, he's a liar—provided the osteopath had a steady pressure when she told this. A slap won't do it; grab the wrist between your fingers.

Here's another little shop kink the osteopathers are putting over: Disease is the father of bacteria rather than bacteria the cause of disease. Another variation of which was first, the egg or the hen?

Paper says Austria yearly sent to us 1,634,070 bushels of beans, and that soon there'll be a bean famine because of the war. How 'bout it, you New England engineers? Neutrality is all very well, but this is a blow below the belt that calls for reprisals.

The management says that the Panama-Pacific Exposition will open on time, which is Feb. 20, 1915. Fifty-six million dollars has been invested in it, a rather substantial evidence of faith in its success. Here's hoping that Science, Art and Industry will take their lead over the usual merry-go-round and popcorn shows that obtain at fairs.

We ask leave to print that a Los Angeles Prohibitionist has been elected to Congress, Our own personal leanings toward Prohibition do not actuate this announcement so much as that, believing in fairness, we think every party should have at least one representative in Washington.

Herewith the "Cincinnati Enquirer" is bluntly accused of exceeding bad taste. Under the title, "The Song of the Empty Growler," said paper prints a "poem" about a girl who worked in a boiler shop pounding rivets all day long "and she was very dry." She wishes she had a drink The foreman rushes the said receptacle, drains its contents and hands the lady riveter the empty can. Then she sings—Say, isn't all this disgusting? In the first place, no boiler-shop foreman would be so impolite as to— We repeat, isn't this disgusting?

When we get going strong on our South American industrial campaign, will we again hear that cry about loose methods of crating and shipping? There's no use wrapping Orsat apparatus or electric meters in tissue paper, have 'em just precede a steam locomotive into the ship's hold—and expect the senors to be tickled with their purchase. If we don't know how, let's ask J. Bull or Billy Hohenzollern; goodness knows, they've been sending enough stuff down that way up to now.

Have a dim recollection that power plants once had chaps called oilers. Never see them mentioned in cold print these days. Oh, yes, he's the feller that polishes the brass and fills the lubricators. Mebbe if the engineers occasionally let him key-up, put a unit on the board or take the meter readings, or suchlike, he might from sheer gratitude write and tell us he's still a part of the force.

New York Combined Associations Hold Annual Ball

The thirteenth annual entertainment and reception of the combined associations of the N. A. S. E. of Manhattan, Bronx and Queens was held at Terrace Garden, New York City, on the evening of Nov. 7.

Among the invited guests were National President Frederick L. Ray, Louisville, Ky.; National Vice-President Walter H. Damon, Springfield, Mass.; National Secretary Fred W. Raven, Chicago, Ill.; National Treasurer Samuel B. Forse and National Trustee George W. Brownhill, Pittsburgh, Penn.; National Trustee Henry W. Mistele, Milwaukee, Wis., and Robert Larkin, business manager of "The National Engineer." There was also a number of past national presidents in attendance. Large delegations were present from Philadelphia, New Jersey and many of the New England cities.

The hall was tastefully decorated. An interesting vaudeville entertainment preceded the dance. It was impossible to complete the elaborate march planned by Floor Manager Frank Martin of Jenkins Bros., owing to the crowded condition of the hall, and for the same reason no picture was taken this year. Frantzen's thirty-piece orchestra furnished the music.

VISITING NATIONAL OFFICERS ENTERTAINED

On Friday evening Phœnix Association No. 24 held a special meeting for the reception of the national officers and guests. The several speeches were interspersed with entertainment by "The Bunch" and refreshments were served at intervals. Fred Felderman, president of the New York State Association, was the toastmaster.

A banquest was held on Saturday evening at 6 o'clock p.m., at which the national officers were the honored guests.

On Sunday afternoon there was an automobile trip to Long Beach, L. I., concluding with a dinner at the McAlpin Hotel, New York City. On Monday they attended the matinee performance at the New York Hippodrome after which the officers and guests boarded their trains for home.

The associations comprising the combination are Brotherhood No. 1; James Watts No. 7; Protective No. 23; Phœnix No. 24; Manhattan No. 25; German-American No. 29; Empire No. 32; Stevenson No. 44; Mott Haven No. 47; Insurance No. 56; Progressive No. 15.

Heating Boiler Explodes

On the afternoon of Oct. 26 a 30-in., six-section, cast-iron heating boiler exploded at the undertaking establishment of Costello Bros., 2324 West Lake St., Chicago. One man was killed and two were injured.

The boiler was about two years old and had been heating with hot water a two-story brick building 150 ft. long, and 30 ft. wide. This fall its location had been changed to the rear of the first floor and it was being remodeled to heat by steam under a maximum pressure of 10 lb. A steamfitter and helper had been working on the boiler and the piping the day of the accident. The boiler was supposed to be empty and a fire of kindling and paper had been started to test out the draft. The steamfitter had just gone upstairs to inspect the flue when the boiler let go, blowing a hole in the brick wall nearby and scattering the boiler over the floor. The four inner sections were badly broken while the two outside sections were only slightly damaged.

The cause of the explosion is not definitely known, but it is supposed that some water got into the boiler. After the explosion the valves on the steam supply and return mains were found open. One radiator had been connected and it is possible that it might have contained some water, as last season it formed part of a hot-water system. This water could have been forced back into the return pipe by pressure due to heating the air in the boiler. The usual result of turning cold water into a hot cast-iron boiler followed.

On the work bench nearby lay a 1-in. safety valve. It had not been put in place on the boiler, nor could any evidence be found of a fusible plug. No permit had been sought from or granted by the city, so the boiler had not been inspected. In fact, the steamfitters had not completely finished their work. The damage to property was comparatively small. Including a new boiler, it should not exceed $500.

Location of Condensers—The hotwell of a barometric condenser should have a volume above the lower end of the discharge pipe equal at least to the combined volumes of the pipes above it. It will then be impossible for a slug of water to be drawn back into the exhaust pipe by the breaking of the water seal. The cone should be well above the head water, say, at least 3 ft., and 36 ft. above the hotwell overflow to give the most satisfactory results.

Recent Court Decisions

Digested by A. L. H. STREET

New York Labor Law Valid—The section of New York's Labor Law which requires employers to allow their men at least 24 hours rest in every week was lately sustained as being valid, as applied to employees of power companies, in the case of People vs. Niagara Falls Power Co., 149 "New York Supplement," 45.

Element of Damage in Condemning Land—In condemning land along a stream for water power purposes, the owner is entitled to an award covering depreciation in the market value of his remaining land caused by destruction by the improvement of a ferry affording him access to a particular market. (Georgia Supreme Court, Central Georgia Power Co. vs. Cornell, 81 "Southeastern Reporter," 882.)

Landlord's Obligation to Furnish Power—Under a lease of space in a building for light manufacturing purposes, requiring the landlord to furnish such power as he has available, the tenant is not entitled to recover damages for the landlord's failure to furnish power, resulting from an unavoidable breakdown of the power plant which occasioned only temporary cessation of power. (Chicago Embossed Moulding Co. vs. Max G. J. Hoffman, 184 Illinois Appellate Court Reports 617.)

Shares in Dam Privileges—The mere fact that three different parties who use a dam for power purposes contribute to the repair of it in certain proportions does not conclusively establish their right to share in the flow of the water impounded by the dam in the same proportions, according to a recent decision of the Appellate division of the New York Supreme Court, announced in the case of Lyon vs. Piser, 149 "New York Supplement," 197.

Safety of Fireman's Place of Work—In a recent suit involving a manufacturing company's liability for injury to its fireman, who fell into an ash pit while the boiler room was clouded by steam, it was held that the mere fact that the company permitted steam to escape into the room and allowed windows to remain broken out, so that cold air coming in contact with the steam condensed it, did not establish such negligent failure to provide a safe place of work for the fireman as rendered the company liable for the accident. Wajer vs. United States Brewing Co., 184 Illinois Appellate Court Reports 545.)

Oral License to Maintain Dam—Although it is a general rule that an interest in land must be granted by a written instrument, founded upon a valuable consideration, in order to be valid, the Florida Supreme Court decided the other day that where an owner of land has granted oral permission for the construction and maintenance of a dam or other improvement upon his land for the benefit of another, and the latter person has constructed such improvement at large expense, the license is irrevocable by the owner of the land or his successor, although nothing of value may have passed in consideration therefor. Albrecht vs. Drake Lumber Co., 65 "Southern Reporter," 98.)

Responsibility for Boiler Explosion—When an owner of a power plant expressly or impliedly invites persons to come upon the premises, he owes them a legal duty to use a reasonable degree of care to avoid their injury; but he is not an insurer of their safety. This legal principle has just been applied by the Kentucky Court of Appeals in a suit brought for the death of a customer at a mill, caused by explosion of a boiler. (Branham's Administrator vs. Buckley, 166 "Southwestern Reporter," 618). In affirming a judgment which denied the plaintiff's right to recover, although the plaintiff's evidence tended to show that the explosion resulted from permitting the water to run too low and by then forcing cold water into the boiler, the court said: "The evidence was conflicting but we cannot say that the verdict is flagrantly against the evidence. The jury evidently felt some doubt as to the exact cause of the accident; and, having in mind the fact that there is a general disposition among men to preserve their property, and among operators of steam boilers to preserve their own lives, and that ordinarily these motives will secure that degree of care which the defendants were charged with under the law, the jury doubtless believed that the injuries to plaintiff's intestate were occasioned, not as the plaintiff contends, by negligence of the defendants, but rather by one of those unfortunate casualties which ordinary care and prudence will not always prevent."

PERSONALS

Frank Martin, formerly chief engineer with the American Hard Rubber Co., College Point, New York, has accepted the appointment as chief engineer with the Trenton & Mercer County Traction Corporation, Trenton, N. J.

Wolfgang Turnwald, formerly assistant to Prof. Johann Stumpf, of Charlottenburg, Germany, is now associated with the Stumpf Una-flow Engine Co., Syracuse, N. Y., in connection with the design of the Stumpf Una-flow engines.

De Witt Smith, formerly of Meriden, Conn., and more recently chief engineer of the Trenton & Mercer County Traction Corporation's plant, Trenton, N. J., has been appointed chief engineer of the Methodist Book Concern's building at 150 Fifth Ave., New York.

ENGINEERING AFFAIRS

Annual Dinner of Washington Society of Engineers—The annual dinner of the society will be held at Rauscher's, 1034 Connecticut Ave. N. W., on Thursday evening, Nov. 19, 1914, at 7.30 in the evening. W. A. McFarland is chairman of the banquet committee.

Second Annual Industrial Welfare and Efficiency Conference—The Department of Labor and Industry of the State of Pennsylvania is arranging for its second annual conference on industrial efficiency, welfare and safety at Harrisburg, Penn., Nov. 17, 18 and 19. The first part of the program will be in three general sections dealing with industrial betterment, compensation and the unemployment problem. During the remaining time it will be divided into four sections, safety, hygiene, welfare and fire-prevention. These sections will take up the specific problems already under consideration by the State Industrial Board or which need to be solved, and will present so far as possible practical information and suggestions which can be put into force in Pennsylvania for the advantage of both labor and industrial prosperity. All individuals interested in industrial affairs are invited to attend and take part in the proceedings. The first session will be called at 10 a.m., Tuesday, Nov. 17, in the State Capitol. In connection with the conference will be held an unusually effective safety welfare and efficiency exhibition, which opened on the morning of Nov. 16 and will close on the evening of Nov. 20.

NEW PUBLICATIONS

EXAMINATION OF LUBRICATING OILS. By Thomas B. Stillman. The Chemical Publishing Co., Easton, Penn. 9x6 in., 125 pages; cloth. Price, $1.25.

The rapid increase in the variety of machines, each with its own lubricating needs, not only complicates the methods of testing oils owing to a wider variety used, but it necessitates careful selection. This book gives in reasonably simple form, instructions for making the many tests which oils should be given. There are 116 illustrations and many tables and charts. Testing methods, specifications and laboratory report forms as adopted by various railroads and other large consumers of oil are given.

Most of the illustrations are pen-and-ink, and are well done, but many of the halftones are poor, although this is the only criticism we feel justified in making.

HEAT—By E. M. Shealy, assistant professor of steam engineering, University of Wisconsin. Published by McGraw-Hill Book Co., New York. Size, 6x9 in.; 262 pages; 110 illustrations. Cloth. Price, $2.

This is a textbook designed to supply students and practical engineers with the elementary knowledge essential to the study and understanding of heat-using machinery, such as the steam engine, the gas engine, the refrigerating machine and the air compressor.

The first part of the work is devoted to the fundamental laws relating to the nature, generation, transfer and transformation of heat with examples of practical application. The latter part of the text treats of the principles of heat and refrigerating machines and the relation of the laws of heat to those classes of machinery, sufficient treatment of each class being given for one who has had no experience with them to understand the relation of the laws, their principles and their operation. Chapter IV on transferring and measuring heat and the concluding chapter on house heating should be found of value to operating engineers who are interested in heating systems.

At the end of each chapter are about ten examination questions pertaining to subjects treated in the text, rendering the work of greater value to teachers and examiners and an aid to the reader in testing his knowledge of the subject. The illustrations, while not elaborate, have the merit of explicitness and completeness and the details are drawn with reasonable regard to actual proportions of the machinery and apparatus referred to without loss of emphasis.

A number of appropriate tables are quoted, such as coefficients of expansion, composition of fuels, heat given off by radiators, properties of steam, specific heats of substances, etc., making the work a good reference and textbook for operating engineers and firemen.

BOOKS RECEIVED

GEARING. By A. E. Ingham D. Van Nostrand Co., New York. Cloth; 181 pages, 5½x9 in.; illustrated; tables. Price, $2.50.

STEAM CHARTS. By F. O. Ellenwood. John Wiley & Sons, Inc., New York. Cloth; 91 pages, 7x10 in.; illustrated; tables. Price, $1.

COAL GAS RESIDUALS. By F. H. Wagner. McGraw-Hill Book Co., New York. Cloth; 179 pages; 6x9¼ in.; 44 illustrations; 31 tables; folding plates. Price, $2.

SHEET METAL WORKING. By F. Georgi and A. Schubert. D. Van Nostrand Co., New York. Cloth; 151 pages, 5½x8¾ in.; 125 illustrations; two folding plates Price, $3.

GRAPHIC METHODS FOR PRESENTING FACTS. By Willard C. Brinton. The "Engineering Magazine," New York. Cloth; 371 pages, 7x10¼ in.; 256 illustrations. Price, $4.

EXAMINATION OF LUBRICATING OILS. By Thomas B. Stillman. The Chemical Publishing Co., Easton, Penn. Cloth; 125 pages, 6x9 in.; 116 illustrations; tables. Price, $1.25.

GAS, GASOLINE AND OIL ENGINES. By G. D. Hiscox and Victor W. Page. The Norman W. Henley Publishing Co., New York. Cloth; 640 pages, 6x9¼ in.; 435 illustrations. Price, $2.50.

CATALOGS WANTED

Martin R. Carpenter, who has opened an office at Room 62, Pickering Bldg., Cincinnati, Ohio, as refrigerating engineer, would be glad to receive catalogs and price lists from manufacturers of ice and refrigerating machinery, etc.

NEW EQUIPMENT

ATLANTIC COAST STATES

Bids will be received until Nov. 21, by James Wood, Pres. Bd. of Mgrs., New York State Reformatory for Women, Bedford Hills, N. Y., for boiler house equipment, underground feeders and ground-lights at the Reformatory. Plans on file at 1224 Woolworth Bldg., New York, N. Y.

The City Council, Burlington, N. J., will change the motive power at the pumping station from steam to electricity at an estimated cost of $6000. Four pumps operated by electric motors will be installed. The Public Service Electric Co. will furnish the necessary energy.

Press reports state that the Adams Express Co. is considering the equipment of a power station at Second and I St., Washington, D. C. The cost will be about $15,000.

Plans are being prepared by F. L. Austin, 240 College St., Burlington, Vt., for the construction of an addition to the power house of the House of Correction, Rutland, Vt. J. E. Weeks, Rutland, is Chn. of the Com. in Charge.

A switchboard, costing $4000 will be installed at the plant of the Webster & Southbridge Gas & Electric Co., Southbridge, Mass. J. S. Shaw, Webster, is Mgr.

The capital stock of the United Illuminating Co., New Haven, Conn., has been increased by $500,000. Improvements will be made at the New Haven plant. R. A. Manwaring, New Haven, is Mgr.

SOUTHERN STATES

The City Council, West Monroe, La., contemplates installing a municipal light and power plant.

According to press reports, plans are being prepared by B. L. Baldwin & Co., Perin Bldg., Cincinnati, Ohio, for the construction of a power house for Rohen & Martin, at Maysville, Ky.

The Kellogg Toasted Corn Flakes Co., Battle Creek, Mich., is having plans prepared by W. J. Morehouse, 343 South Dear-